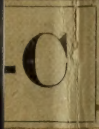


Cover, G. - On the myology of the *Homithorhynchus* (1871).



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Prof. A. Hyatt,

With the author's respects

SEP 24 1902

IX. *On the Myology of the Ornithorhynchus.*

BY ELLIOTT COUES.

ALTHOUGH the Ornithorhynchus has been repeatedly dissected in Europe, such is not the case in this country; where, moreover, no treatise on its anatomy is generally accessible. We publish, therefore, notes of a recent dissection of the muscles, rather with the design of partly supplying a want that many students must have felt, than with the idea of advancing anything new or specially important; although, we should add, some of the muscular homologies are discussed upon a hypothesis of antero-posterior symmetry not yet generally received. We are indebted to Prof. Agassiz for the use of a specimen from the Museum of Comparative Zoölogy, Cambridge, received through the kind attentions of Prof. Wilder; an adult male, in good condition, except that the head was severely shattered by a charge of small shot.

We find it convenient to group the muscles in the following manner, which probably, also, is not entirely unnatural:—

I. CUTANEOUS MUSCLES.

II. VERTEBRAL MUSCLES.

a. *Of the Head.*b. *Of the Neck.*

a'. Anterior vertebral.

b'. Posterior vertebral—and not upward prolongation of dorsal muscles.

c. *Of the Back.*d. *Of the Tail.*

III. CERVICAL MUSCLES:—superficial, not connected with vertebræ or scapula.

IV. THORACIC MUSCLES. (Intrinsic.)

V. ABDOMINAL MUSCLES. (")

VI. PERINEAL MUSCLES. (")

VII. MUSCLES CONNECTING THE SHOULDER-GIRDLE WITH THE BODY.

VIII. MUSCLES OF THE ANTERIOR EXTREMITY.

a. *Acting upon the humerus.*

a'. — From the body; "long."

b'. — From the scapular arch; "short."

b. *Acting upon the forearm.*

a'. — From the body; "long."

b'. — From the scapular arch; — "long."

c'. — From the humerus; — "short."

c. Acting upon carpo-metacarpus, from humerus or forearm.

d. Acting upon digits.

a'. — From humerus or forearm.

b'. — From carpo-metacarpus.

IX. MUSCLES CONNECTING THE PELVIS WITH THE BODY.

X. MUSCLES OF THE POSTERIOR EXTREMITY.

a. Acting upon the femur.

a'. — From the body; "long."

b'. — From the pelvis; "short."

b. Acting upon the leg.

a'. — From the body; "long."

b'. — From the pelvis; "long."

c'. — From the femur; "short."

c. Acting upon the tarso-metatarsus from femur or leg.

d. Acting upon the digits.

a'. — From femur or leg.

b'. — From tarso-metatarsus.

The intrinsic muscles of special organs belong rather to a treatise upon those organs than to one upon the general muscular system, and are not included in the present memoir.

I. CUTANEOUS MUSCLES.

The animal may be said to be tied up in a fleshy sack, with six principal openings for the head, tail, and four limbs. This muscular tunic is remarkable not only for its great extent, but for its thickness in most parts, the various directions of its fibres, and the number and diversity of its accessory slips and their attachments. It is everywhere intimately adherent to the skin; so closely, that in fact it is difficult or impossible to dissect it cleanly from the integument. On the other hand, its connection with the body is correspondingly loose, through the medium of copious areolar tissue especially lax and abundant over the back, chest and sides, dwindling over the episternum and front of the neck, and giving out on the limbs. Practically it will be found best to raise the panniculus with the skin in large, well defined flaps (taking care to note its several definite bony attachments), clear off the cellular tissue, and study it from the inner side. It will be found to descend upon the limbs nearly to the wrists and ankles, where it is drawn tight, like the wristband of a sleeve. The muscle may be further described in detail as follows:—

Panniculus carnosus.—It begins behind by a pointed extremity on either side of the tail near its base, made up by several (about four) fleshy digitations arising from as many transverse processes of coccygeal vertebræ—the first or anterior digitations being opposite the great caudo-tibial muscle. The two sides of the muscle soon come together over the back of the tail, there forming a deep reëntrant angle; after thus joining, the single plane, at once becoming very thick,

runs up the back and sides with uninterrupted longitudinal fibres. On the ventral surface of the tail, there is a similar coalescence of the two sides, at a point just in front of the anus, or just behind where the *intertibialis* crosses from one side to the other; the plane, thinner than that on the back, runs uninterruptedly up over the belly.

Some distance behind the leg, the longitudinal fibres part on the side of the body preparatory to forming the leg-opening. But across the triangular space that would thus be left, semicircular loops are thrown, with less and less belly from behind forward, until they are nearly transverse just at the back of the leg; these sweep around the leg on both sides, embracing it and then coming together again in front of it; the opening thus made is pyriform in shape, with the point forward. A little above the heel, the muscle and skin together are pretty firmly attached, not only to a naked space on the tibia, but by dense areolar or fascial extensions, containing much fat, betwixt the tendons of the muscles.

Where the *intertibialis* crosses, this is firmly connected with the panniculus, though not to any special detached slip of the latter that we could discover.

Uninterruptedly surrounding the whole body, and with simple longitudinal fibres, the muscle runs up to the neck. The provision for the arm-opening is essentially the same as that for the leg-hole, only the point of the pyriform orifice is directed backward; the muscle descends on the arm; some fibres have definite attachment to the lower third of the ulna; others less definite fascial connection on the other side, with the lower end of the radius, and with the septa betwixt the flexor tendons of the wrist.

A few longitudinal fibres are continued from the breast up to the neck; with the exception of these, and of the hyoid fasciculus, to be presently noticed, the fibres are here transverse, without a median raphé, and sweep over the sides of the neck; they extend quite to the back, and overlies the cheek-pouches. These transverse fibres, and in general, all of the muscle upon the ventral aspect of the body, are thinner than those on the dorsal; and there is a remarkable thickening, as a longitudinal band, along the side of the neck, formed in a manner noticed below.

Its special slips and their attachments. — An *hyo-dermal* muscle is thus formed: Over the episternal bar, a curved fan- or horn-shaped set of fasciculi are developed from the inner surface of the panniculus; these curve inward as they pass forward, narrowing to definite fleshy insertion into the body of the *os hyoides*, on either side of its median line, in mutual apposition. A *brachio-dermal* is formed over the *latis-simus* and side of the thorax generally, by a heavy reënforcement to the inner surface of the muscle, of a broad, fan-shaped plane growing

thicker and narrower as it passes forward to definite insertion (fleshy, or by a very short tendon) into the pectoral crest of the humerus, alongside the insertion of the *pectoralis major*. The anterior border of this *dermo-brachialis* corresponds in a general way with the posterior border of the great pectoral. A third distinct slip, large and important, forms what may be called the *costo-dermal fasciculus*. It arises by two definite fleshy digitations from the 12th-13th ribs, respectively 1' and $1\frac{1}{2}'$ from the back-bone, and forms a long, slender, flat ribbon, that runs straight up the side of the body along the anterior border of the lower trapezius, underneath the main plane of the panniculus, lying upon the latissimus, to the shoulder; passing just behind the elbow, widening over the shoulder, becoming then blended with the panniculus along the side of the neck, then separating again, and finally inserted into the back part of the cheek-pouch.

In considering the form and uses of this great muscle, probably representing the extreme case of its development in the mammalian series, we are struck first with its nearly equal and essentially symmetrical presence on both the anterior and posterior halves of the body. Acting as a whole we see how, in connection with the thick skin, dense fur, and subjacent flocculent areolar tissue, it contributes to fill up the various irregularities of the surface of the body, and produce a shape offering least resistance in passing through the water; while, moreover, this everywhere contractile tunic must largely assist in producing the various undulatory motions of a body suspended in a fluid of nearly its own specific gravity. Its two lateral caudal prolongations resemble tiller-ropes to guide the side motions of the rudder-like tail; its two lateral costal slips bend the whole body sideways. The hyoid slip is a retroductor of that bone, in action intermediate between sterno- and omo-hyoid. The brachial fasciculus acts like an accessory *pectoralis major*. The cheek-pouch slip pulls that organ directly backward, and appears to be in antagonism with the special orbicular muscle that surrounds and contracts the pouch; while the transverse fibres that spread over the latter compress it and assist the orbicular muscle in emptying it. (The dissection was here a little obscure, owing to laceration of the parts; but we believe such is the arrangement.) Finally, the fascial attachment of the muscle at the lower arm and leg, where the limbs protrude through the orifices, renders the panniculus an accessory mover of the limbs in various directions.

II. VERTEBRAL MUSCLES.

a. Of the Head.

Unfortunately, the shattered state of the parts prevented any satisfactory dissection here.

b. Of the Neck.

(a'. — Anterior vertebral.)

Scalenus.—There is but one—a small insignificant slip proceeding to the first rib, to be inserted opposite the origin of the first digitation of the *serratus magnus*. It lies on the extreme side of the neck, just in front of the cervico-scapular muscle, and appears to begin there, with attachment at the middle of the neck; but it is really continuous by a slight tendinous intersection, with a portion that runs higher up, with attachments all along to its real origin, definite, at the apex of the spur of the hypapophysis of the atlas.

Longus colli.—An upper portion is not demonstrably distinct from the lower; its place is apparently taken by the unusually large muscle next succeeding. The muscle lies upon the bodies of the vertebræ, with attachments by slips as usual to 5-6 processes, from first dorsal upward; below, it terminates inside the chest.

Rectus capitis anticus major.—Large; arising both tendinous and slightly fleshy from the basioccipital just in front of the articulation, passing down over the hypapophysis of the atlas without attachment thereto, in apposition with its fellow; forming a distinct fleshy fusiform belly, traversing the whole length of the neck in front, with attachments by slips to the anterior aspect of transverse processes, more or less blended with the similar digitations of the *longus colli*.

R. c. a. minor?, or *lateralis?* (possibly neither, as it has no origin from the atlas).—A rather large muscle, arising fleshy from the whole length of the transverse process of the *axis*, passing upward across the atlas, between its transverse process and its hypapophysial spur, narrowing as it ascends, to the head (insertion destroyed in the specimen). Just back of this muscle, and appearing like a prolongation of it, interrupted by the transverse process of the atlas, a little muscular plane runs from the process just named to the roots of the spinous processes of 3d-4th cervical vertebræ. This is entirely distinct from the series of cervical *intertransversales*.

(b'.—Posterior vertebral—and not upward prolongation of dorsal muscles.)

The two *recti capitis postici*, if these occur, were completely destroyed.

Obliquus inferior.—Of great size, as in some marsupials that, like *Didelphys*, have greatly developed cervical spinous processes; and resembling a second *complexus*, but of course without cranial attachment. A bulging fleshy mass, arising muscular from the sides of the spinous processes of axis and next 3 vertebræ, by 4 digitations; passing obliquely upward and outward to be inserted fleshy into the whole upper surface of the transverse process of the atlas. A powerful rotator of the head, as in the action of shaking it sideways.

O. superior.—A small terete muscle, arising fleshy from the poste-

rior corner of the edge of the transverse process of the atlas, and proceeding straight up to — (the head? — insertion destroyed).

Splenius. — (Upper half much mutilated); apparently no distinction of *S. "capitis"* and *"colli."* Below, a large, rather thin, fleshy plane, passing a little obliquely from the head downwards toward the middle line of the neck; terminating about opposite the last cervical vertebra, where, and for a little distance below, it is united with its fellow by a tendinous raphé. Superficial, with the usual relations to all deep-seated muscles.

Complexus. — (Destroyed above); below, an oblique plane, of rather small size, just internal to the *trachelo-mastoideus*; inserted by about 4 fleshy digitations into the spinous processes of as many lower cervical vertebræ.

Biventer. — (Mostly destroyed); but, as well as we can determine from the mutilated remains, differentiated from the *complexus*; a terete fascicle along the median line of the back of the neck, with no tendinous intersection.

Trachelo-mastoideus. — (Destroyed above; arises from mastoid. — Owen); below, a mostly distinct and rather terete than digitate muscle, separating *complexus* from "*transversalis colli*," and somewhat blended with the latter. No tendinous intersections observed; insertion by about 3 closely approximated, and in fact, blended, thick, fleshy digitations, into the bases of the transverse processes of as many lower cervical vertebræ.

c. Of the Back (with their cervical prolongations).

Not to enter upon details alike tedious and fruitless, we may rather briefly notice the conformation of the special muscles of the back.

Disregarding for the time the caudal prolongation of the longissimus, the *erector spinæ* may be said to begin over the pelvis opposite the tip of the ilia; it is at the outset completely differentiated into "*longissimus dorsi*," or erector proper, and "*sacro-lumbalis*" or "*iliocostalis*;" the latter, separate in its whole extent, is not further divided into a "*musculus access. ad s.-lumb.*;" it continues up the neck as "*transversalis colli* and *cervicalis ascendens*," which are separated by the *trachelo-mastoid* and *complexus* from the corresponding cervical prolongations of longissimus proper, viz., semi-spinalis dorsi et colli, and multifidi. To this general indication we may add the following descriptions:

Longissimus. — In the loins a remarkably distinct, flattened terete belly, almost wholly muscular, without dense aponeurotic investment, and with only a few (3-4) distinct fasciculi or digitations, that arise from lumbar transverse processes. Already differentiated, as just said, from sacro-lumbalis, the muscle runs upward with a nearly uniform width, and straight, somewhat free, outer border; opposite the last

rib it becomes invested with a glistening aponeurosis, at first slight plain and single, but readily resolvable (more especially a little higher up) into a series of oblique fascial tendons running inward and upward, with pretty definite insertion into apices of successive transverse processes; the arrangement is clearest at the top of the thorax but is essentially the same throughout. Now on raising the outer border of the whole muscle, and dividing successive costal attachments so as to reflect it over towards the spine and expose its under surface, a perfectly regular series of tendino-muscular slips is brought to view. Counting 2-3 lumbar ones, there are about 14 in all, arising distinct and tendinous, from transverse processes, passing obliquely upwards and outwards. These are best displayed along the middle of the back; they terminate opposite the 3d and 4th ribs, at least as far as *longissimus dorsi* is concerned, being transferred to the outer (costal) branch of the erector (*i. e.*, cervical prolongation of *sacro-lumbalis* = "*transversalis colli*"). Above this point the *longissimus* dwindles into characters of *semi-spinalis dorsi et colli*; and the few muscular-tendinous fibres pass obliquely downward and outward, instead of upward and outward, like those of the back. External to these, "*transversalis colli*" lies along the side of the neck, betwixt the digitate insertion of the *trachelo-mastoid* and the "*cervicalis ascendens*," blending with both of these. It may be said to arise from the most prominent transverse processes of cervical vertebræ, by tendon scarcely separable from that of the *c. ascendens*; it passes downward and obliquely backward, ending with *longissimus* opposite the 3d and 4th ribs, with fascial attachments all the way.

Sacro-lumbalis. — This is the outermost of three different planes that may be distinguished in the loin (*longissimus* making a fourth). It is there a thin fan-shaped plane, taking definite origin from the tip of the ilium, and passing upward spreading over the ribs. This costal expansion is continuous over the whole length of the thorax (with no differentiation into "*musc. accessorius*"), and entirely separate from any part of the *longissimus*; it is wholly costal, without vertebral attachment. It is an inch and a half broad at its widest part; its outer border is very convex, and runs a little back of the line of the digitations of the *obliquus abdominis*; its inner or posterior border is straight, and corresponds with the outer border of the *longissimus*; the plane is very thin, and intimately attached to each rib as it passes over it; to the eye, in fact, it resembles a set of supernumerary intercostals, with perpendicular instead of oblique fibres; we should judge it to be more of a respiratory muscle than a back-straightener. Towards the top of the thorax it grows narrower, and becomes, on the neck, *cervicalis ascendens*, differentiated from other nuchal muscles by the intervention of *trachelo-mastoideus*, and

lying the most laterally of any of them. It finishes by insertion, by an aponeurosis of blended tendons, into the 4-5 lower cervical vertebræ, at the apices of their transverse processes.

A second lumbar plane is thicker and narrower; like the last, it arises from the apex of the ilium, and runs to the last rib; it may be a disintegration from the sacro-lumbalis; but it seems to represent lumbar continuation of a series of 'levator costarum'?

Quadratus lumborum.—This is rather thin, subtriangular, arising, like the two last, from the iliac extremity and passing to the last and next to the last, rib, with attachment also to vertebræ on its way.

Thus there is no very remarkable deviation from a usual standard, nor any specially interesting conformation of the cervico-dorsal vertebral muscles. Among notable absentees, however, the *serrati postici* may be mentioned. As a whole, the back muscles are not very large; those of the nape exceed them, comparatively; and these again are surpassed in development and complexity of structure by the caudal muscles destined to move the great heavy thick-skinned, fat-laden tail that acts as a rudder when the animal is swimming.

d. Of the Tail.

Levator caudæ.—This is the uninterrupted prolongation of the longissimus to the tip of the tail. As the muscle passes down over the back of the sacrum, it forms a single thick terete fleshy belly on either side, filling the deep groove between the ilium and vertebral spines, soon tapering and filling the similar groove on either side between spinous and articular processes of caudal vertebræ, with attachments all along its course. These last consist, on the upper part of the tail at least, of distinct tendons terminating the muscular fasciculi that are given off; they are implanted into zygapophyses. Towards the tip of the tail, such definite arrangement is scarcely or not demonstrable.

Extensor lateralis.—The median extensor of the tail is small compared with this lateral one that forms the chief bulk of extending muscle. The latter is incompletely divisible above into two portions; the larger one arises from the back of the iliac extremity; the smaller and more lateral portion lower down on the same bone; the two are afterward blended. The superior part mostly fills the fossa between articular and transverse processes, lying upon the latter. Its upper surface is invested with a strong dense fibrous sheath, that may be split into numerous tendons, each of which arises from a partly differentiated muscular fasciculus. Tendons thus extend to the tip of the tail, but most of them pass a little obliquely inward towards the median line for insertion,—an arrangement most obvious along the middle of the tail. The lateral bundle of the muscle gives off from its border and under surface about 6 distinct tendons from muscular fasciculi, that pass to definite insertion into the tips of the transverse

processes of as many caudal vertebræ; beyond, it is indistinguishable from the rest of the muscle.

Flexor lateralis.—The smaller of the two perfectly distinct caudal depressors is wholly ischio-coccygeal, arising definitely from the tuberosity of the ischium by a broad fleshy origin. It is a somewhat square, entirely fleshy plane proceeding obliquely outward and downward to be definitely inserted by about 3 digitations into the transverse processes of as many coccygeal vertebræ, just in advance of the origin of the caudo-tibial muscle.

Depressor caudæ.—The principal flexor of the tail is the largest of all, as well as the most complex in structure; and doubtless, to judge from the obliquity of its segregated fascicles, it subserves other movements of the member. It arises, first, inside the pelvis just behind the acetabulum, and at the junction of the haunch-bone with the sacrum; it may be said, further, to take continuous origin thence to the tip of the tail, from the apices and under surfaces of all the transverse processes. The fibres are very oblique; except at first, in fact, it may be regarded as a series of many such diagonal slips, partly blended together. The under surface is invested with an extremely dense glistening aponeurosis, made up of a number of obliquely set, overlapping or imbricated laminæ of fascia, each of which is the broad flattened tendon of a muscular fasciculus. These aponeuroses combined are the tendon of insertion of the muscle into the vertebral bodies from near the base to the extreme tip of the tail.

Besides the foregoing caudal muscles, there is a series of well developed intertransversales; and another set of smaller slips runs along the articular eminences. The tibio-caudal muscle, although attached to transverse processes, as it passes by them, extends to the median line of the tail underneath, by a thin, broad, flat tendon that lies external to the main flexor of the tail.

III. CERVICAL MUSCLES:— Superficial, and not connected with vertebræ or scapula.

Under this head will be noticed the sterno-mastoid and principal muscles of the hyoid apparatus. The first named is double on each side, unless one portion is "cleido-mastoid." The hyoid muscles exhibit a remarkable tendency to run together, both by lateral blending and by end-to-end joining, in several cases where among most animals they are distinct.

Sterno-mastoid.—The *superficial* portion is the larger: it arises by a short flattened tendon from —— ("the mastoid"—*Owen*; insertion destroyed), and forms a stout, somewhat flattened belly that descends obliquely inward, exactly parallel with, and contiguous to, the anterior border of the trapezius, to be inserted fleshy and by a

very short tendon, into the episternum, a little below and in front of the edge of the bar, on either side of the median line, in apposition with its fellow. It forms, as usual, the letter X with the omo-hyoid. The deep portion is much smaller; it has a separate but contiguous tendon of origin "from the mastoid," and in the neck lies directly beneath, and in apposition with, the other for its whole length. Though thus entirely covered, its course, particularly below, is a trifle oblique to that of the superficial portion, whereby it gains, at length, the outer border of the latter, becomes superficial, and is inserted into the border of the episternal bar, at junction of first and middle third, where the insertion of trapezius ends.

Hyoid Muscles.—The fleshy band that lies upon the wind-pipe is barely or not separable, without forcing the dissection, into right and left halves; there is no distinction whatever of a *sterno-thyroid* from *sterno-hyoid*; nor is a *thyro-hyoid* demonstrable. The common band of muscle arises inside the thorax on the median line, from the lower part of the inner surface of the manubrium sterni (not from the episternum), and runs uninterruptedly up the trachea to the larynx. The median part of the band is attached above to the thyroid cartilage, while the lateral portion passes up without attachment to be inserted into the side of the os hyoides, and especially into the enlargement of the greater cornu; this portion, moreover, appears continuous with *hyo-glossus*. In like manner *mylo-hyoid* and *omo-hyoid* are connected, if not continuous, at the hyoid bone; there is trace of a tendinous intersection, but the hyoid insertion (into the side of the body of the bone) of the two is identical, and some at least of the muscular fibres are not interrupted. The *mylo-hyoid* passes a little outward as it goes to the jaw, and is inserted fleshy upon the outside of the ramus, partly overlapping the latter, and being itself partly overlapped by a muscle to be presently noticed (*a*). There is no evident distinction of *genio-hyoid* from *genio-hyo-glossus*; though these are united (or separated, if the term be preferred) by a tendinous intersection; but the *genio-hyo-glossus*, on the other hand, is mostly distinct from the *hyo-glossus*. The *genio-hyoid* runs obliquely forward and spreads outward, partly in apposition with its fellow, to be inserted along the greater part of the ramus of the lower jaw, like the *mylo-hyoid*, instead of culminating at the symphysis menti. The *genio-hyo-glossus* forms as usual a vertical plane, in apposition with its fellow on the median line; behind, it has the ordinary attachment to the os hyoides, and is considerably blended with the *hyo-glossus*; its anterior connections are rather with the *genio-hyoid* than with the jaw itself. The *hyo-glossus* is the longest and most distinct muscle of the three, though continuous behind with the *sterno-hyoid*, as already stated; it forms a terete bundle on either side of the under surface of the tongue.

(a).—A small muscle somewhat resembling another mylo-hyoid, arises with its fellow from the hyoid on the median line, and proceeds forward and outward, spreading over the jaw at its narrowest part, to be inserted into the lower lip.

Another little muscle lies upon the outside of the ramus of the lower jaw, taking definite origin, fleshy, from the fossa at the end of the groove in the bone; it is distributed to the integument of the lip. Transverse fibres of the panniculus, and the muscle *a*, also contribute to the fleshiness of the part.

Other muscles of this region could not be dissected owing to the condition of the specimen.

IV. THORACIC MUSCLES proper.

These were not dissected.

V. ABDOMINAL MUSCLES.

The muscular walls of the belly conform to the usual marsupial type in the great size and fleshiness of the obliquus externus, extreme thinness and verticality of the obliquus internus, fleshiness of transversalis, thoracic prolongation of rectus, and extent of pyramidalis. They are chiefly noticeable for the absence of inguinal opening. The quadratus lumborum, often referred here, has been already considered.

Obliquus abdominis externus.—Arises by fleshy digitations from all the vertebral ribs except the two first—the first digitation being continuous with the lower slip from the *serratus magnus*; and separation into digitations becoming obsolete on the last 2-3 ribs; with origin also from lumbar fascia and tip of the ilium. The posterior border of the muscle presents a concavity towards the spine, the most distant point being at the middle of the thorax, about 3 inches from the vertebræ. Except at the extreme lower portion the muscle is fleshy, with the usual direction of its fibres; these continue as far forward as the outer border of the rectus. The insertion is aponeurotic into the whole linea alba, and symphysis pubis; and fleshy into whole length of marsupial bone, its upper edge; at the tip of the latter, there is also an aggregation of fleshy fibres of insertion. There is no arrangement for abdominal rings or 'pillars.'

Obliquus internus.—Extremely thin, and with some difficulty demonstrable from the *transversalis*, even in its muscular portions; but on holding the wall up to the light, the fibres may be distinctly seen decussating with those of the transversalis nearly at right angles. The aponeuroses of the two are blended and completely inseparable after passing beyond the tolerably well defined 'linea semilunaris,' where the muscular fibres of both end. The fleshy part arises mostly, if not wholly, from the iliac extremity, and passes upward with little,

if any, obliquity, terminating at the broad oval cartilages of the floating ribs, as high up, at least, as the 10th from the last.

Transversalis.—Larger and better defined than the last; arising from the whole lower margin of the thorax, internal to the oval cartilages, by slips interdigitating with the diaphragm, from the xiphoid cartilage to the last rib, and thence from the innermost lumbar fascial septum (and so from transverse processes of vertebræ) to the apex of the ilium. The muscle is thickest above, where some fibres reach quite to the linea alba, for 3-4 inches below the xiphoid; further down these cease at the linea semilunaris in the broad thin aponeurosis of median insertion common to this muscle and the foregoing. All the muscular fibres are directly transverse.

Rectus abdominis (internus).—Is thoracic as well as abdominal—a long continuous ribbon from episternum to pubes. It arises fleshy at a point at the top of the thorax where epicoracoid, coracoid, episternum, manubrium and first rib meet, taking attachment from all these bones, and also slightly from the next rib as it passes down. On the thorax it rests a little on the sternum, but mostly lies along the ends of the ribs, overlaid by the pectoralis major, and crossed at bottom of the sternum by the obliquus abdominis (some of the fibres of which appear to blend with the outer border of the rectus without reaching the median line). The abdominal portion is a little wider and thinner, in apposition with its fellow along the linea alba, separated from the obliquus externus by interposition of the pyramidalis, and lying wholly exterior to the conjoined aponeurosis of obliquus internus and transversalis—these not forming a sheath below, as in man. The insertion is into symphysis pubis and brim of that bone as far outward as the termination of the articulation of the ossa marsupii. There are no ‘lineæ tendineæ transversæ.’

Pyramidalis, s. Rectus externus.—Of great length; and broad at base, in consequence of the outward divergence of the marsupial bones, from the whole length of which (their anterior border), and from the symphysis, the muscle arises. The outer border represents a line from the tip of the marsupial bones to the xiphoid; the inner corresponds to the linea alba. The lowermost fibres are almost directly transverse; the others become successively less oblique to the axis of the body, and finally are nearly longitudinal; the muscle runs to a point above, and is fleshy throughout. It approximates and appresses the marsupial bones, counteracting the obliquus externus, which divaricates them. It is thus in indirect subservience to the reproductive process, in an early state of the young; and similarly, the thoracic prolongation of the rectus internus furthers the bending of the animal in voluntary self-assistance during parturition and subsequent care of the young, as in ordinary marsupials.

VI. PERINEAL MUSCLES.

Not dissected.

VII. MUSCLES CONNECTING THE SHOULDER-GIRDLE WITH THE BODY.

Of the several muscles connecting the scapular arch with the body, the deep portion of the sterno-mastoid, which is really essentially clavicular in its insertion, has been already considered. The omo-hyoid, as usual, forms the direct muscular band between the hæmal arches of consecutive cranial vertebræ, in this repeating an ordinary intercostal. The others are in three sets, arising from *a*, spinous processes of vertebræ along the median line, *b*, processes of cervical vertebræ along the side of the neck, and *c*, from the thorax. Trapezius is in two parts, one of which is thoracic, while rhomboideus is single; the cervico-scapular plane, answering to 'levator anguli scapulæ,' is double; besides which, there are, as in ordinary marsupials, two perfectly distinct atlanto-scapular levators. The costo-scapular plane (serratus) is small and slight, and differs from that of some (all?) marsupials in being entirely distinct from levator anguli proper; there are also other thoracic muscles passing to the shoulder apparatus. As a whole, the scapular arch is much less mobile than usual, in consequence mainly of the episternal attachment and coraco-sternal articulation.

Omo-hyoid.—As already stated, continuous with the mylo-hyoid, at its hyoid point of insertion; and there is no division into two bellies by a tendinous intersection, nor any confining of the muscle in its continuity by an aponeurotic pulley. Above it is partly divisible into two fasciculi, the smaller internal one of which is inserted lower down on the hyoid than the other, and is distinct from mylo-hyoid. The muscle forms a single flat ribbon, at first descending nearly straight down the neck, then passing obliquely outward, crossing behind the s.-mastoid, between this and levator anguli scapulæ, and dipping beneath the episternal bar, to be finally inserted on the scapula, partly fleshy and partly tendinous, just below the acromion, in a notch half way between clavicular and humeral articulations. The ordinary action.

Trapezius.—Large; distinct from deltoid, as in claviflate animals generally, and further resolved into two entirely distinct portions, as if by disappearance from the back between and in advance of the shoulders, of the part corresponding to the aponeurotic space of the human subject. The *anterior part* arises from the occiput (precise limits of origin not visible in the specimen), and thence down the median line of the neck, by an aponeurosis common to it and its fellow, with only secondary connection with cervical spines, to a point opposite the most prominent part of the scapula, to which the lower border

of the muscle runs transversely; the anterior border folds around the side of the neck parallel and in apposition with the s.-mastoid; the insertion is partly fleshy, partly tendinous, into the scapular spine, and border of episternal bar, as far to the front as the insertion of the deep s.-mastoid. The posterior part arises from the 10th–11th ribs by two fleshy digitations situate respectively 1' and 1½' from the back-bone, and from a broad, oval, dorsal aponeurosis common to it and its fellow. The muscle has the form of a narrow scalenè triangle; its lower border approaches the spine about the middle of the back, and is there contiguous with its fellow; the anterior border passes straight up the side of the chest, lying upon the latissimus, past the back of the arm; the acute apex is inserted by a very short, thick tendon into the end of the scapular spine, in connection with the posterior corner of the insertion of the anterior trapezius, and of the deltoid behind — the latter curving down in front of the arm, which is thus set in a deep recess betwixt these two muscles. Under this portion of the trapezius, in the deep hollow of the back between the shoulders, the large gland lies embedded in copious lax areolar tissue. When the two parts of the trapezius act together the effect is much the same as if they were not disjoined; the special effect of their disjunct action, if they have such, is not so evident.

Rhomboideus.—Single; of large size, and thick. It arises in apposition with its fellow along the median line of the neck behind (disposition above, and cranial attachment, if any, not seen); the lower border passes transversely to the scapula, and a little downward; the insertion, broad and fleshy, is into the apex behind, and about ½' along the posterior border of the scapula. Has the usual action.

Costo-scapularis; serratus magnus s. anticus.—Perfectly distinct from the cervico-scapular plane, from which it is separated by a triangular interval an inch wide in front, narrowing behind as the two muscles mutually approach towards the apex of the scapula. The muscle is unusually small, consisting of only three short digitations from 1st–3d ribs, rapidly lengthening from first to third, the last almost perfectly continuous with the first slip from the obliquus abdominis; the three fascicles remain distinct near to their insertion, which is by a short terete tendon into the very tip of the scapula. Has the usual action.

Pectoralis minor?—Besides the serratus, another plane of muscle connects the shoulder apparatus with the top of the thorax; it has somewhat the situation and relations of an 'intercostal' betwixt first rib and the bones above. It is divisible into two parts. One of these, costo-coracoid, is larger and thicker than the other; it arises from the first rib, from the origin of the serratus magnus slip to the sternal articulation, and is inserted mainly into the base and inner surface of the coracoid. A smaller, thinner plane, manubrio-epicoracoid,

expands upon the internal surface of the epicoracoid plate. The first of these may be pectoralis minor; the second, subclavius?

The cervico-scapular attachments are several, and rather complicated. We have, first, two distinct muscles, both arising from the spur of the atlas hypapophysis, but with separate scapular attachments; each of these is a single belly. Then there are two planes of digitate muscles, each arising from several cervical processes, and with different scapular insertions. These last probably represent duplicate levatores anguli scapulæ proprii; while the two first named (also occurring in marsupials and other animals) are "protractores scapulæ."

"*Atlanto-acromialis*."—A single thick stout muscle, lying superficial and somewhat to the front, as well as on the side, of the neck, nearly parallel with the omo-hyoid, crossed above by the sterno-mastoid, and overlaid by the trapezius. With the tendinous origin above mentioned (hypapophysial process of atlas) it soon swells to a large belly, and is inserted fleshy into the antero-interior aspect of the scapular crest, and thence in a line behind the episternal articulation as far as the insertion of the omo-hyoid. It draws the shoulder-blade towards the head, and a little to the front.

"*Atlanto-scapularis*."—Origin with the preceding, and in like manner; and overlaid by it in the upper part of its course. It passes a little more obliquely as it descends, lying upon the deeper muscles of the back of the neck. It has somewhat the appearance of an enlarged and distinct fasciculus of levator proper, with which it is inserted, fleshy, into the antero-internal surface and upper border of the scapula near its apex. Action nearly the same as that of the foregoing, but more oblique.

Levatores anguli scapulæ.—A double plane, with common digitate origins, but separate insertions. Each numbers about 6 slips of origin from the transverse processes of the first dorsal and all the cervical vertebræ except the atlas and axis; the slips are separable nearly to their insertion. The posterior, or internal plane lies directly upon the muscles of the back of the neck; it is quite flat, fan-shaped, and converges from its broad origin to be inserted fleshy, into the posterior extremity of the scapula, from the apex one-half-inch up the blade. The digitations are all terete, and lie in the same plane. The other muscle lies anterior to the last; its digitations are broader and flatter, enlarge as they pass to the scapula, and are packed obliquely against each other. The lowermost slip does not reach the scapula, ending in tendinous insertion into the next above; the other five have fleshy insertion into the antero-internal surface of the bone, chiefly on a line near the edge of the crista. The action of both planes is much the same; they draw the bone around to the front and upwards, rotating it a little.

VIII. MUSCLES OF THE ANTERIOR EXTREMITY.

The arrangement indicated in the beginning seems to us fully as convenient as, and much more natural than, grouping the muscles of the limbs upon, and naming the several sets after, the parts upon which they lie, instead of those on which they act.

The humerus, like that of the mole, an animal which uses its forelimbs in corresponding manner, is short, thick and extremely irregular in superficies, with strong elevations and depressions for advantageous arrangement of the muscles. The bone may be regarded as a knotty osseous nodule interposed between shoulder and elbow-joint for the strong movement of the forearm in several directions; itself moving through little space, but capable of being very powerfully pulled in every direction, and thus laying the foundation, as it were, for the various strong movements of the forearm. It is acted upon, from the body, by the dermo-brachial slip already described, and by the two following muscles:—

a. Acting upon the humerus.

(a'. — From the body.)

Latissimus dorsi. — Notable for its extensive costal, and correspondingly slight spinal, origin. It arises by aponeurosis from about 6 dorsal vertebræ (4th–9th), beginning above at a point just opposite the shoulder, to which, therefore, the upper border passes directly transverse; most of this spinal portion is thicker than the costal. The latter origin is by a series of fleshy slips from the 7th to the 14th ribs, in a slightly irregular curved line the convexity of which is forward; the digitations are separable for some distance, especially the few lower ones. No aponeurosis connects this costal with the spinal portion; such fascia having apparently been appropriated by the lower trapezius and costal slip of panniculus, already described. The lower, outer border of the muscle ascends very obliquely; before insertion, there is a complete twist, as usual, the upper fibres becoming lower by twisting *outwards*; and conversely. Insertion by a short, wide, thin, flat tendon in an oblique line upon the humerus, half-way up the pectoral crest, and thence along the entocondylar ridge to the elbow. The muscle has its ordinary action, very advantageously effected by its extensive and low insertion.

Pectoralis major. — Of remarkable extent. Its origin is in a line from the acromion and whole episternal bar, and thence down the manubrium and sternum and linea alba to within a couple of inches of the pubes. Along the front of the chest it has thick fleshy origin from the ends of the ribs as well as from the breast bone. The abdominal portion is extremely thin — thinner than the same part of the panniculus; the muscle thickens rather abruptly as it passes over the lower

edge of the thorax, and there, near the median line, a slight cellular interval may occur between thoracic and abdominal portions. The chest portion is of nearly uniform, and great thickness; there is no evident distinction of a deep-seated from a superficial part; but the outer half of the episternal portion and the acromial portion are together* separable from the sternal portion, by a slight cellular interval along a line representing the posterior border of the muscle below described as the anterior part of the deltoid. (This last named muscle is crossed at right angles, overlaid, and mostly hidden by the pectoralis.) The rather thin outer border of the pectoralis is nearly in a straight line from the symphysis pubis to the shoulder; the thoracic part of this border lies nearly parallel with the anterior border of the obliquus abdominis. The thick convex anterior border dips down over the posterior border of the deltoid to the humerus. All the fibres of this great muscle converge *without* twisting to an extensive linear insertion by a short stout tendon into the pectoral ridge of the humerus. The acromio-episternal bundle of fibres is set in much lower down than the others, from which they are virtually separated by the insertion of the slip from the panniculus. The pectoralis has the usual action, carried to a high degree; it is also, owing to the great development of the pectoral crest, an unusually powerful rotator of the humerus, an action in which the latissimus assists. The purpose here subserved is evident on reflection upon the way the paddle-like hands should strike the water when the whole arm is *forcibly extended* in giving the backward stroke.

(b.'—From the scapular arch.)

Deltoid.—(According to high authority, the deltoid is double, and the two muscles about to be described may constitute its two halves; but the anterior of these, which is overlaid and covered by the pectoralis, would hardly recall a deltoid by any physical feature.) The posterior part is of pyramidal shape, with thick fleshy origin from the most anterior (highest) part of the scapula, and a low insertion on the humeral crest by a rather long tendon. Some of its fibres of origin appear almost continuous with those of the posterior trapezius; while it is almost blended with the pectoralis at its insertion. The anterior portion lies upon the epicoracoid plate, conforming

* These portions together are in the ordinary position, and have much the appearance, of a deltoid—in fact, they resemble one much more than the muscle, below described as “anterior deltoid,” does. We are in doubt of the accuracy of our identification of the muscle we describe as anterior portion of the deltoid, but can come to no more satisfactory conclusion, without identification of what is described in a preceding paragraph as “Subclavius? Pectoralis minor?”—a determination that we cannot at present make. One of the inner pectorals of birds may furnish the clue.

in contour with the latter; fleshy fibres take origin from the whole surface of that bone. The muscle narrows and curves a little as it passes down, directly overlying the shoulder-joint, and in relation anteriorly with the long epicoracoid head of the biceps, to be inserted fleshy into the most prominent part of the pectoral crest of the humerus, above the insertion of the posterior deltoid. When these two muscles act together, they would have the usual effect in elevating, or abducting, the humerus; acting separately, they have little of this effect, but are respectively extensors and flexors of the bone, with a slight rotating power in opposite directions.

Independently of the foregoing, there are the usual number of scapulo-humeral muscles; but owing to the singular shape of the shoulder-blade, position of its faces, and other causes, it becomes somewhat of a question what names are to be applied to them. We describe them accurately, and if mistaken in identification there will be no trouble in rectifying the error. We determine subscapularis, both spinati, no teres minor, and double teres major, making five in all, as usual.

Supraspinatus.—A slender, straight fascicle, much the smallest of the three that more especially occupy the shoulder-blade. It arises fleshy in the depression between the most prominent point of the scapula and the glenoid—that is, about half-way betwixt these two points, and partly around on the antero-internal aspect of the bone (owing to the reflexion of the latter), close by the insertion of the omo-hyoid; it passes straight to the joint, which it directly overlies, and is inserted by a short, flat tendon into the anterior tubercle at the head of the bone, just opposite the proximal beginning of the insertion of the epicoracoid part of the coraco-brachialis. It rotates the humerus outward, as usual directly opposing the subscapularis.

Infraspinatus (and teres minor? or the latter wanting?).—Largest of the three. Occupies, and arises fleshy from, the whole of the scapular plate below the spinous elevation, that is, between the last named and the origin of the scapular head of the triceps; narrowly fan-shaped and slightly curving, to be inserted, partly fleshy and partly tendinous (tendon superior and muscular part infero-external), into the posterior aspect of upper part of pectoral crest, just below insertion of the preceding, which it powerfully aids in rotating the humerus outward.

Subscapularis.—This is in what would be for most animals the usual position of “*infraspinatus*,” and might be taken for the latter, were it not for its widely distant insertion into the other side of the head of the humerus. A rather small subterete fascicle, arising fleshy from that part of the scapula which lies between the glenoid and head of the triceps extensor brachii; crossing to the shoulder-

joint behind to be inserted, chiefly fleshy, into the posterior tubercle upon the head of the humerus. It rotates the bone inwards, feebly counteracting the two preceding muscles.

Teres major. — Double; both portions of great size, and perfectly distinct. The *lower*, or *teres major* proper, arises fleshy from the posterior extremity of the scapula for about one-third of an inch; it lies at first upon the serratus magnus, and then along the superior border of the latissimus, forming a great pyramidal muscle running between the last and the upper *teres*, rapidly narrowing to a rather long, stout, flattish tendon that passes behind (mesiad of) the scapular head of the triceps, to be inserted in the posterior ridge of the humerus, one-half inch or more above the insertion of the latissimus. On its deep surface muscular fibres reach nearly to its insertion; on the superficial aspect, the large glistening tendon radiates nearly half way to origin. The *upper* portion is still larger, and has more extensive and complicated origin from both "sides" of the scapula, which is thus, as it were, embraced by the muscle. The outer origin is from the postero-external aspect of the scapula, from the origin of the lower *teres* to that of the scapular head of the triceps; the inner origin is thinner and more extensive and fleshy, from the whole surface of bone between the insertions of the two digitate sets of levatores scapulæ. The muscle is pyramidal in shape, like, and with the general aspect of, the preceding, and with precisely similar tendinous arrangement. But it is inserted much higher up, in immediate relation with the shoulder-joint, into the posterior tubercle of the humerus, alongside the insertion of the muscle above called subscapularis. N. B. Its tendon contains an articular sesamoid bone.

Two perfectly distinct muscles besides the one above called "anterior deltoid" proceed from the coracoid apparatus to the humerus; they have together been considered as coraco-brachialis, but the name is properly applicable to only one of them.

Coraco-brachialis proper. — This is the posterior, and the longer and slenderer of the two. It arises by a very short tendon in common with the larger moiety of the *biceps*, from the sternal extremity of the coracoid; quickly enlarges to form a flattened-fusiform muscular belly, representing the postero-internal margin of the arm; it is overlaid by the greater moiety of the *biceps*, itself overlying at first, the muscle next below described, and afterwards the tendon of the *latissimus*, which it crosses at right angles. Its insertion is fleshy and with a very short tendon, into the lower part of the entocondylar ridge of the humerus, nearly opposite the foramen: its outer surface of insertion is in relation with the pronator radii *teres*.

Epicoraco-brachialis. — Much larger than the other, and with different origin, course, relations and insertion; lying partly upon and

partly under, the whole coracoid apparatus, and upon the posterior aspect of the proximal moiety of the humerus. Viewed at first from the outside, superficially, it appears to arise from coracoid proper, and to descend thence upon the humerus. But its real origin is much more extensive, from the whole, or nearly all, of the under (internal) surface of the epicoracoid lamella, as a thin expanded plane, whose contour is determined by that of the bony plate just named. It gains the outside by curving around the coracoid proper, reminding one of the escape of the iliacus over the pelvic brim, or of obliurator internus over the border of the ischium. It has a broad fleshy insertion into the expanded surface of the humerus, upon the aspect of that bone above noted, as far down as the insertion of the latissimus. These coraco-humeral muscles adduct and retroduct the arm, bringing it upon the breast, as in the act of clasping; and have furthermore somewhat the action of internal rotators of the bone.

This extensive and somewhat complicated disposition of the coracobrachial muscles, and their perfect differentiation into two, are in striking contrast with the singularly small and simple condition of the (single) muscle in some animals of the next order above, as the opossum for instance. It is the nearest approach of which we are aware, to the ordinary condition of the antitypic muscles of the hind limb, which are always differentiated into several adductores femoris.

b. Acting upon forearm.

Only one forearm muscle comes from the body: it is the slip from the latissimus. Of the other "long" brachial muscles, the biceps is doubled above, and has a singular disposition; the scapular head of the triceps ("long" extensor cubiti) is entirely discrete from both the other ("short" extensors) heads, for a reason we disclose below. The brachialis anticus ("short" flexor cubiti) is not remarkable. Perhaps the most interesting point regarding the muscles of this part is the remarkable development of the anconæus, and the presence of another antagonistic anconæus, both in subserviency to the peculiar motion that the elbow-joint permits in lieu of pronation. The pronator teres—that very constant muscle in higher vertebrates—is present under ordinary conditions, although there is no pronation possible in the forearm; so also are the two supinators (but the pronator quadratus is wanting?).

Before proceeding to consider the muscles that act upon the forearm, we may notice the method of adapting the whole limb for use as a paddle. The humerus, as we have already seen, is extremely short and thick, and is especially broad across the condyles, where the width is but little less than its whole length. We have also seen that the principal muscles that extend, *i. e.*, retroduct, the humerus,

in the act of giving the stroke to propel the body through the water, are so inserted as to have a strongly rotating effect upon the bone, twisting the limb in such a manner as to throw the elbow up and away from the body. Now the two bones of the forearm are in mutual apposition for their whole length, and so closely bound, that relative motion upon each other is abrogated; the forearm is confined permanently in a state of semi-pronation. But it is evident that the broad surface of the webbed hand must strike the water in the backward stroke, and that the thin edge of the palm must cleave the water in the bringing forward of the member; that is, there must be perfect virtual pronation and supination during each stroke and return to position for the next one. With the forearm bones stiffly bound together to ensure strength and fixity of the wrist and hand, this requisite rotation of the forearm and change through 180° of the plane of the webs is effected by the construction of the elbow-joint, and disposition of the muscles that act from the humerus and scapular arch upon the proximal end of the forearm. The elbow, instead of being the most strict ginglymus in the body, as usual among mammals, is largely amphiarthrodial, permitting free rotation or lateral rocking of the forearm upon the humerus. This compound motion seems to be very nearly like what would occur as a resultant if, in man for instance, the rotation of the head of the radius in its ulnar socket should enter as a component of, and be merged into, the to-and-fro swinging of the forearm upon the humerus. In a word, the animal *feathers its oars at the elbow-joint* — not at the wrist.

In studying the action of the several muscles concerned, we see clearly how this is effected and find the reason for certain peculiarities in their disposition. We have only to add further, in this connection, that the articular facet of the humerus is not directly at the end of the main axis of the bone, but displaced to one side, so as to be at the base of the immensely developed ectocondylar process; that both the widely divaricating condylar processes offer salient *points-d'appui* for the muscular tractions that rotate the forearm; and that the olecranon is a very broad plate curving far up behind the humerus, with widely expanded corners, in subserviency to the varied action of different parts of the triceps and anconæal muscles.

(a'. — From the body.)

Dorso-epitrochlearis. — The forearm slip from the latissimus is well developed. It is given off obliquely from the lower border of the muscle, a little more than an inch from its humeral insertion, and mounts upon the back of the forearm, crossing the limb over the most prominent ridge of the latter. It appears to end in fascia over the middle of the back of the forearm; but may be traced, without unduly forcing the dissection, to pretty definite insertion into the

ulna itself, at about the middle of the bone. The slip is of a nearly uniform width of about a third of an inch, and is thin and flat; it has the usual action.

(b'.—From scapular arch; “long.”)

Biceps.—The coraco-radial flexor is in two parts, with rather unusual disposition; one of the “heads” is much larger than the other, and the two arise far apart; but they are implanted together upon the radius. The anterior part—*epicoraco-radialis*—arises fleshy high up on the epicoracoid plate from its border and postero-interior moiety, where it is overlaid by the episternum, and soon forms a slender terete fascicle, which passes outward in relation with the origin of the rectus abdominis, subsequently overlies the anterior portion of the coraco-brachialis, and then comes in relation of contiguity with the other moiety of the biceps, which it separates from the pectoral crista humeri. Passing this last, it changes to a long terete tendon that represents the anterior border of the biceps where this dips betwixt the forearm muscles. The posterior and larger part—*coraco-radialis*—arises from the sternal extremity of the coracoid in common with one head of the coraco-brachialis, and immediately swells into a great, broad, flattish, fleshy belly that passes down the arm lying a little obliquely upon both the coraco-brachiales, and subsequently upon the tendon of the latissimus dorsi. It becomes penniform by insertion into the tendon of the other head of the biceps; posteriorly, the muscular fibres nearly reach the radius. The common insertion of the two is by a broad flat tendon into the middle third of the radius.

(The other (ulnar) flexor cubiti is noticed under the next head, c').

Triceps, its long head. *Rectus humeri*!—The “long” or scapulo-ulnar extensor of the forearm is remarkably distinct from the two humeral, or “short” heads. It arises fleshy from the posterior concave border of the scapula, from the glenoid an inch or so backward. It is thus a rather thin broad plane, that passes between and separates the two teretes majores (see above) from the other scapulo-humeral muscles; as it descends the back of the arm, it narrows in one transverse direction, and thickens in the other, so that here its greatest diameter is at right angles with the same diameter above. The anterior (glenoid) edge of the muscle is at first in apposition with the posterior surface of the brachialis internus; after the above mentioned change in the long diameter of the muscle, its broad flat surface is similarly applied to the equally expanded surface of the brachialis internus. In place of the tendinous inscriptions that commonly unite this scapular head below with both the humeral heads, we have them separated by cellular intervals. Neither is there an aponeurotic investment of the muscle below; but it has a wholly fleshy, thin,

broad from side to side, insertion with the remarkably wide posterior border of the olecranon.

(c'. — From the humerus; "short.")

Triceps, its internal head. *Vastus internus humeri*! — This muscle is of large size, and wholly distinct from the foregoing; it is not divisible into fasciculi. It is fleshy throughout, and of a somewhat pyramidal shape, being broadest below. It lies almost directly posterior upon the humerus, and fills up what would otherwise be a great fossa between the head of the humerus and the olecranon. Its relations are — behind, to the scapular head of the triceps, which is applied flat to its whole surface; in front, mostly to the humerus itself, but also in greater or less part to the brachialis anticus, origins of both inner and outer bundles of forearm muscles, and to the muscle below described as *antanconæus*; to the outer side, to external head of triceps; to the inner side, to lower part of brachialis anticus, and tendon of latissimus. It takes fleshy origin from the whole of the upper half of the back of the humerus, and is inserted fleshy into the whole width of the edge of the olecranon. At the innermost point, some fibres are collected into a slightly separable bundle, which has more especial and partly isolated insertion into the inner corner of the olecranon.

Triceps, its external head. *Vastus externus humeri*! — Like both the foregoing, entirely distinct, and remarkable for its comparatively small size, its isolation from the humerus in its continuity, its definite tendinous origin and insertion, and peculiar, independent action. The muscle is fusiform in general shape, but somewhat prismatic in a transverse section; it lies entirely away from the humerus, upon the outer aspect of the arm, in a bed formed between the brachialis anticus and inner head of triceps. It arises by two tendons; one is a narrow, flat, strong band from a recess behind the "greater tuberosity" of the humerus; the other a broader, shorter, more diffuse and aponeurotic-like fascia from what would be "neck" of an ordinary humerus. It is inserted by a short, definite tendon into the extreme outer corner of the transversely expanded olecranon.

This last division of the triceps, while extending the forearm like the other two, more especially pulls upon the outer corner of the olecranon, and tips it up sideways, thus producing (in connection with the *anconæus*) the remarkable rotation of the forearm that answers instead of pronation. The inner head has the reverse action less plainly marked, while the scapular head is the direct extensor; but both these two last have so broad a fleshy insertion into the olecranon, that if they contract unequally in their different parts, they may have corresponding effect in tipping the olecranon sideways. The several actions of the triceps, as a whole, are furthered by the follow-

ing muscles—one of which is an immensely developed *anconæus*, and the other its peculiar antagonist:—

Anconæus.—Of remarkable size and partly divisible into two portions. One of these occupies the lowest part of the humerus behind, somewhat in the position of what is called *subanconæus* in anthropotomy; it lies beneath the internal head of the triceps, filling the fossa between the olecranon and the humerus below, arising from all the broad depression between the two condylar ridges. It is triangular in outline, but really tetrahedral in shape, and entirely fleshy. Its fibres pass downward, backward, and very obliquely outward, directly over the back of the elbow-joint, to be inserted into the whole of the superior surface of the olecranon; but some are continuous with the other part of the muscle, or *anconæus* proper, passing for this purpose through the deep notch between the ectocondyle and the outer angle of the olecranon. The superficial portion of the muscle, however, has pretty distinct origin from the ectocondyle, and thence spreads out fan-shaped, to be inserted fleshy into the whole outer and back surface of the ulna as far along as the origin of the *abductor pollicis longus* (except just along the edge and at the tip of the bone, which are reserved for origin of *extensor carpi ulnaris*). The attachments and oblique traction of this muscle make it a powerful rotator of the forearm upon the humerus, as well as an extensor. It is opposed by

Antanconæus.—A muscle of considerable size that lies very obliquely across the *inner* side of the back of the elbow. It arises from the tip of the entocondyle in connection with the pronator and carpal “flexors,” and immediately forms a thick, bulging fleshy belly that rather suddenly contracts to a short, stout, rounded tendon to be definitely inserted into the prominent tubercle at the inner corner of the olecranon. The muscle lies mostly upon the expanded inner condyle and fills up what would otherwise be an hiatus between the inner head of the triceps below and the ulnar head of the “flexor” carpi ulnaris. It subserves the rotary motion of the forearm, as well as extends the latter; producing a movement corresponding to supination, and thus directly counteracting the foregoing.

Brachialis anticus.—(Flexor cubiti ulnaris.) Returning now to the flexor set, we find that the “short” or humero-ulnar flexor of the forearm is large and lies rather outside, than in front, of the humerus, in consequence of the singular shape of that bone; it only gains the front more than half way down, and runs up the outside of the bone nearly to the shoulder-joint. Arises, fleshy, from all the depressed space between the great pectoral crest and the prominent ectocondylar ridge; it is overlaid, above, by the external head of the triceps. Becoming anterior, at length, between the condyles, it dips down between the widely separated bundles of forearm-muscles, and narrows

by lateral flattening to be inserted tendinous into the ulna, along the radial edge of that bone from scarcely beyond the elbow-joint half way to the wrist (there being no coronoid process for its definite insertion).

Thus the two flexors of the forearm, ulnar and radial—inner and outer—preserve ordinary relations in the forearm; the biceps not splitting below to have part of its insertion into the ulna, as in certain marsupials. There are only two other muscles that act upon the forearm, viz.: the round pronator and short supinator; for the square pronator is absent, and the long supinator, as usual among mammals, is a humero-carpal muscle. The arrestation of this muscle on its way to the carpus and its insertion into the styloid process of the radius, is a teleological modification only found among the very highest mammals.

Pronator radii teres.—Although the forearm is fixed in semi-pronation, this constant muscle is well developed. It is not, however, superficial, and so determining the contour of the part, nor does it arise first or highest up on the entocondyle, but it is deep-seated, and overlaid in greatest part by the "*flexor*" *carpi radialis*. It is a single terete subfusiform belly, with origin from the entocondyle next below the last named muscle, passing obliquely to be inserted into the middle third of the radius by a rather long, flat tendon, in relation, on its radial aspect, with the tendons of biceps and brachialis anticus. Its function is limited to steadying of the parts.

Supinator brevis.—A deep-seated, triangular plane of moderate size; its outer, free border stretches in a straight line between the tip of the ectocondyle and the middle of the radius, and the body of the muscle fills the depression between these points. It has no ulnar origin; but arises from the anterior border and tip of the ectocondyle, and has definite, fleshy insertion into the upper half of the radius—ending just in advance of a point opposite the insertion of the pronator teres. It counteracts this last, but its action must be very limited.

c. Acting upon carpo-metacarpus, from humerus or forearm.

The contour of the forearm is that of a flattened flask, broad above, and rather suddenly contracting to a narrow neck towards the wrist. Above, the fleshy bundles are widely separated, by the whole distance between the tips of the expanded condyles of the humerus; they are thick and bulging, which may be said also of the muscles upon its back. As usual, the aggregate bulk of the muscles upon the front is greater than that of those upon the back; but the latter are more numerous. The disposition of the muscles is simple, compared with that of most higher unguiculates, and there are several notable absences, as will be stated further on.

Before noticing the individual muscles that act upon the wrist, we should explain the necessity of changing the names of the so-called flexors and extensors. The morphological position of the forearm is with the bones uncrossed in strong supination. Then the palm looks *forward* and downward, with the nails uppermost and pointing *backward*; and in this position the hand is "symmetrical" with the foot, the sole of which looks *backward* and downward, with the nails pointing forward and upward. "Flexion" of a segment is its bending in the contrary direction to that of the segment above; as all admit in the case of the foot, where "flexion" is decreasing the angle formed between the front of the leg and the instep; but the fact has been strangely overlooked by most anatomists in the case of the hand, where apparently its customary pronation has deceived them. "Flexion" of the hand is the bending of that segment in the direction opposite to flexion of the forearm: that is, *backward*, remembering the supine position of the member. The muscles that do this lie upon the back of the forearm and hand, and correspond to those upon the front of the leg and instep; they are those called in anthropotomy the "extensors," but their function is *flexion*. We restore their proper name, and similarly call the "flexors" of anthropotomists, lying upon the front of the forearm, by their proper name of *extensors*.* There is to be no change in the digital flexors and extensors.

The *extensors* (*i. e.*, "flexors" of anthropotomy) of the wrist are only two, ulnar and radial; both of large size.

Extensor carpi radialis. — The first muscle on the ulnar side of the pronator, interposed between this and the flexor digitorum communis; large, and of singularly flattened shape from side to side; very broad above, rather abruptly contracting to a very short and stout tendon. It arises both fleshy and tendinous from the tip of the entcondyle, and thence in a line across the bottom of the humerus in front (dipping into the deep fossa there found) to the radial articulation; and slightly from the head of the radius itself. The tendon, barely one-third of an inch long, mounts a little way up the radial border of the muscle: it is inserted by expanding upon and grasping, as it were, the most prominent carpal bone upon the radial border of the wrist. The usual action.

* Consult further in this connection—

BURT G. WILDER, *On Morphology and Teleology, especially in the limbs of Mammalia*. Mem. Bost. Soc. Nat. Hist., Vol. I. 1865.

JEFFRIES WYMAN, *On Symmetry and Homology in Limbs*. Proc. Bost. Soc. Nat. Hist., p. 277. 1867.

ELLIOTT COUES, *Antero-posterior Symmetry, with special reference to the Muscles of the Limbs*. New York Medical Record. July, 1870, et seqq.; pp. 149-152, 193-195, 222-224, 272-274, 297-299, 370-372, 390-391, 438-440.

Extensor carpi ulnaris. — Of very remarkable size, and bicapital above; whence those who believe in the "serial" homology of the muscles of the limbs might be led to infer that it is the homologue of the *gastrocnemius*. Its two separate portions above both lie flat and superficial; the outer determines the contour of the forearm at the part, the inner is appressed in its whole extent against the flexor digitorum, from which it is separated by a slight cellular interval. The larger (*ulnar*) portion arises fleshy from the very edge of the ulna, its upper three-fourths, and still more extensively from the edge, tip, and outer face of the olecranon; it is flattened-ovate in shape, and has an upper free edge that traverses across the notch between the inner corner of the olecranon and tip of entocondyle, where it is in relation with the "antanconæus." The smaller (*humeral*) portion takes origin from the whole length of the base of the entocondyle. These two parts only fuse just before changing into the stout tendon common to both; the ulnar portion overlaps the condylar. The tendon is longer than that of the extensor carpi radialis; it expands as usual to embrace the pisiform bone. The usual action.

Upon the back of the forearm there are three wrist *flexors* (*i. e.*, "extensors" of anthropotomy); one upon the ulnar side as usual, and only two upon the radial, instead of three (the number when the "supinator longus" is, as it should be, enumerated with this set). Of these two radial flexors the humeral origins and general arrangement at first favor the supposition that they are the "longior" and "brevior" of anthropotomy, and that there is no supinator longus; but the much more important indication afforded by their insertions below determines pretty conclusively, that one of them is supinator longus, and that either the other represents combined longior and breviar, or that one of these last is missing.

Supinator longus. — Here seen in its usual character as a humero-carpal, not humero-radial, muscle. Above, it occupies somewhat the position of the flexor carpi radialis breviar, being shorter than, and wholly overlaid by, the other radial flexor. It arises fleshy from the anterior aspect of the external condyle, below the origin of the following muscle, lying at first upon the humerus and head of the radius, and then upon the supinator brevis; finally, upon the back of the radius; when, becoming tendinous, it passes by the expanded foot of the radius, and is immediately inserted into the *carpus*, its radial side. It is a pure flexor carpi.

Flexor carpi radialis (longior or breviar, or more probably both?). — Rather the largest muscle of the parts, and wholly superficial, overlying both the supinators; apposed externally against extensor digitorum, and on the other side in relation with brachialis anticus and biceps. It arises fleshy from the ectocondylar ridge, from the tip up-

ward for one-third of an inch; becomes tendinous about the middle of the forearm, passes behind the foot of the radius and over the insertion of supinator longus, to spread into a broad fascial tendon, by which it is finally inserted into the bases of the 2d, 3d and 4th metacarpals. From its very high origin upon the humerus, this muscle is the principal *passive* or indirect flexor of the hand when the forearm is extended.

Flexor carpi ulnaris. — While all the other muscles lying upon the forearm, are in greater or less part condylar in origin, this arises wholly from the ulna. It is a flat muscle, lying superficial upon the ulna behind; its posterior border corresponding to the edge of the bone and arising therefrom in greatest part, but also having extensive olecranon origin. It becomes tendinous near the wrist, and is inserted into the base of the 5th metacarpal, partaking somewhat of the general tendency to aponeurotic expansion that characterizes all the tendons coming down upon the back of the hand. As somewhat of a corollary of the last statement, it may be here observed, that the tendons along the back of the wrist and hand are pressed close to the bones, while those upon the front of the wrist and the palm are away from the bones, and are separated by deep distinct interstices of areolar tissue containing much fat.

The other muscles of the forearm all act upon digits, either separately or in common.

d. Acting upon digits.

(a'. — From humerus or forearm.)

There is only one digital flexor upon the front of the forearm. The superficial or "perforatus" flexor is confined to the hand, as the corresponding flexor of the toes is to the sole. Of extensors upon the back of the forearm there are, besides the one common to the fingers, two special ones for the thumb and little finger respectively.

Flexor digitorum communis (profundus s. perforans). — Lies between the radial and ulnar extensores carpi; a muscle of large size, flattened shape, and somewhat complicated structure. It has extensive origin, both from humerus and forearm bones. Its humeral origin corresponds with that of the extensor carpi radialis, but is a little lower down upon the inner condyle and more external; this part of the muscle is larger than the other; it has aponeurotic investment upon both sides, and mainly contributes to form the stout tendon that runs somewhat up in its substance, and is thus, as it were, embraced by two muscular valves. The tendon flattens at the palm, in a direction contrary to the flattening of the muscle above. The ulnar portion of the muscle arises from all of the upper three-fourths of the surface of the bone—excepting a small line along the ulnar ridge which is occupied by the origin of extensor carpi ulnaris — up to the

very tip of the olecranon; it is thus longer than, but not so broad nor strong as, the humeral portion, and is wholly muscular without tendinous intersection. It joins the other portion at the common tendon below.

Between these two portions, and partly separating them, a small distinct fusiform muscular belly lies embedded. It has tolerably definite and distinct origin from the little tubercle on the base of the humerus just internal to the ulnar facet; it runs along in the substance of the digital flexor for an inch or so, and then contracts into a delicate thread-like tendon that we traced distinctly to the wrist, and there lost without making out special insertion. We found what we take for the same muscle in the opossum (*D. virginianus*); there it has precisely the same disposition and relations. It cannot be flexor digitorum superficialis, because we find the latter confined to the palm; nor flexor longus proprius pollicis, since this last must be represented in the portion of the common flexor that corresponds to the first tendon going to the thumb. We take it to be palmaris longus.

The common flexor of the fingers splits at the palm into five, not four, equal and similar tendons. Morphologically speaking, we hold "flexor longus proprius pollicis," when this exists independently, to be merely a differentiation from the common "profound" or perforating set of flexing tendons. Here the deep flexor remains intact, and there can be no dissentaneous motion of the thumb, even did the close webs permit it. The single great tendon passes the wrist flanked on either hand by the wrist extensors (radial and ulnar), filling up the depression between the two prominent carpal bones, to which the tendons of the muscles last named are attached. It fills the palm to a level, forming a thick indissoluble tendinous band, permeated with several small irregular gritty specks, like imperfect sesamoids—one for tendons of little and ring fingers, one for middle and index, with a thumb moiety lying a little to one side of the last. A little beyond the bases of the metacarpals, the tendon divides into five, as already stated. These pass each to the base of the ungual phalanx of a digit, bound down in their course, not only by the ordinary digital sheaths, but by a small stout transverse fibrous band opposite each node. Each perforates, as usual, a tendon of the superficial flexor, and has a lumbricalis, as noticed in detail below.

Extensor digitorum communis.—Arising from the outer condyle next after the origin of the flexor carpi radialis; a subfusiform, laterally flattened muscle wedged between the last named and the extensor minimi digiti, with only one border becoming superficial. With definite pointed origin from the very apex of the ectocondyle, it quickly becomes tendinous; opposite, or a little above the wrist, the tendon

grows broad, thin and flat, and expands still more upon the back of the hand. Individual tendons may of course be traced to the tips of the digits; but they are so blended in one common fascial expansion upon the back of the hand, and upon the digits are so intimately connected with the fibrous sheaths, that they require to be forcibly and somewhat arbitrarily cut apart. Extension of the digits is absolutely consentaneous, so far as this muscle is concerned.

In the muscle is formed a small, distinct, muscular belly, with a delicate abortive tendon, not traceable to definite insertion. This unquestionably represents one of the deep (special) extensors—either extensor indici or of a pollical internode; more probably the former.

Extensor minimi digiti.—Lying next to the preceding, as large as it, and perfectly distinct; in greatest part superficial, overlying the last described, and itself partly overlaid by the flexor carpi ulnaris, a short, stout, spindle-shaped muscle arising from the ectocondylar tip, and passing to the tip of the little finger. Its tendon is very distinct to the back of the hand, where it partakes of the general fascial expansiveness, and is scarcely distinguishable except by arbitrary dissection.

The constancy of this muscle is as remarkable as that of the extensor longus proprius pollicis of the foot, and is specially interesting in such a case as the present, when proper thumb muscles abort or disappear. It goes far towards substantiating the antitypy that we hold exists between the little finger and great toe.

Extensor ossis metacarpi pollicis. “*Abductor pollicis longus.*”—While the foregoing extensors are superficial, this, like the supinator brevis, is deep-seated, being entirely overlaid above. It is the only special thumb muscle—others going to the internodes being wanting. It lies upon the back of both bones of the forearm, arising fleshy from both, but mostly from the ulnar shaft, its middle third, as high up as the elbow joint and insertion of anconæus; its radial origin is only from the head and a trifle of the shaft of that bone. The muscle becomes tendinous a little below the middle of the forearm, where its obliquity increases to enable it to gain the radial side of the limb; it passes under the tendon of the flexor carpi radialis, and over that of supinator longus, across the foot of the radius, and thence runs to the base of the first metacarpal, where it is more definitely inserted than the other extensor tendons are. From its insertion and the obliquity of its tendon, it is a pure abductor, or web-spreader, rather than an extensor.

Although this muscle is inserted into the base of a metacarpal, instead of into a digital internode, it is essentially one of the digital extensor set; and as explained at greater length below, we refer to the “peroneus tertius” of anthropotomy (a muscle that, in some animals,

becomes a pure extensor of the little toe) for its posterior antitype. We hold that the digital extensors of both members are, like the flexor sets, essentially two, a deep, or "long," "perforans," and a superficial, or "short," or "perforatus." Extensor minimi digiti manus, and extensor longus hallucis pedis are differentiations from one set, and mutually antitypic; while extensor indicis, and extensors of the pollical internodes, are representatives of the other set, corresponding to the short extensor that remains upon the instep in the human subject, but which, as in the opossum, may be carried up the leg as one of the peroneal group. "Peroneus tertius" is another of the same group, corresponding with extensor ossis metacarpi pollicis. We recur to the subject again in speaking of foot muscles.

(b'. — From carpo-metacarpus.)

There are no digital muscles, except the dorsal interossei, arising from the back of the hand; on the contrary, several are found upon the palm, among them the flexor digitorum perforatus, as well as the short special thenar and hypothenar muscles, the lumbricales, and palmar interossei.

Flexor digitorum sublimis s. perforatus. — This muscle lies wholly in the palm, as the corresponding "short" flexor of the toes of man does in the sole; and, like the same muscle of, for instance, the opossum's foot, it arises upon and from the common tendon of the "long" or profound flexor digitorum. It is a small muscle, in some danger of being overlooked without due care; but its tendons may be demonstrated to have the essential characters and relations of those of a perforatus set in the customary exhibition of the latter as a muscle of the forearm. It arises as a flat fleshy mass upon the palmar (superficial) aspect of the conjoined tendon of the deep flexor, and speedily splits into fascicles that terminate in delicate tendons that pass to the bases of the fingers, and are mostly inserted into the tendons of the deep flexor a little beyond; but the tendons also spread like two "perforatus" tendons, into an expansion joining the digital sheaths, on either side of tendons of the deep flexor, which are thus embraced in the usual way.

Lumbricales. — Four of the five tendons of the deep flexor muscle are accompanied and reinforced by four accessory muscles, that arise from the dorsal (interior) aspect of the conjoined tendon before it splits, and pass to be inserted as usual into the digital sheaths at the sides of the fingers.

Thenar and hypothenar muscles. — These are nearly alike, of small size, and not dissimilar in general aspect to interossei; but their mode of insertion exposes their character. The short special flexor of the thumb is a small, flat fasciculus arising pretty definitely from the most prominent carpal bone on the radial side, lying along the

same aspect of the palm, and distinctly inserted into the front of the base of the first phalanx of the thumb. This muscle is single, and not separable into adductor, abductor, etc.; but on the hypothenar side we find what we take to be both these muscles acting upon the little finger. An *abductor* (or short flexor?) arises rather broadly from the outer side of the pisiforme, and runs along the ulnar aspect of the fifth metacarpal, to a little beyond the base of the first phalanx of the little finger, where its tendon is lost in the digital sheath. An *adductor* is smaller, a mere thread, arising from the centre of the palm, and running along the inner side of the fifth metacarpal to terminate opposite the other on the side of the little finger.

In this animal, the thumb cannot be distinguished by any function that it has from the little finger; nor by any intrinsic physical character, except its being only two- instead of three-jointed; and the special muscles of these two digits are nearly identical. In "archetypal" condition we hold these digits to be physically identical, and their subsequent differentiation in mobility, direction of axis, number of joints, and muscles acting upon them, to be purely teleological. Originally we may perhaps hold the thenar and hypothenar muscles to be modified interossei, and to be represented each by a single muscle; though as a matter of fact we ordinarily have, from two to four (most commonly three; an adductor, abductor, and flexor brevis) muscles into which each interosseus may have been differentiated. It is interesting to observe, that in this case of the *Ornithorhynchus*, with thumb and little finger so similar, as far as function is concerned, what little difference in the number, etc., of special muscles there is, is in the favor of the little finger, a condition the reverse of usual.

Interossei. — Each of the digits except the two lateral ones has a palmar interosseus; the three are quite similar. They arise almost together from the middle of the palm, and divaricate thence upon the second and fourth fingers. They lie directly upon the palmar aspect of the metacarpals and proceed to split upon the basal phalanges of the fingers, terminating on either side on the digital sheaths. The dorsal are faintly developed.

IX. MUSCLES CONNECTING THE PELVIS WITH THE BODY. — Only one muscle actually passes from the body to be "inserted" in the pelvis, and this, in its action at any rate, is rather a muscle of the back. The numerous other body-muscles that have pelvic attachment, are only incidentally, as it were, connected with that arch, and really belong elsewhere, as to abdomen, perinæum, etc.

Psoas parvus. — Large, much exceeding the other. It arises from vertebral centra (except the last two lumbar) up to about the eighth

and ninth dorsal from below, and by digitations from the contiguous portions of ribs, especially a few of the lower ones. Its flattened tendon, dense and glistening, extends upward upon its anterior border. It has definite insertion into the pectinaeal eminence.

X. MUSCLES OF THE POSTERIOR EXTREMITY.

On reflecting the skin and panniculus, the whole limb down nearly to the heel, is seen to be enwrapped in three large, broad muscles; on the outside lie the enormous *ectoglutæus* and the remarkably expanded *biceps*; on the other side lies the great *gracilis*, second only to the *glutæus* itself in size and strength.

a. Acting upon the femur.

Perhaps the most notable peculiarity is the absence of *glutæus maximus* from this group, this muscle's insertion being carried down to the leg below. *Psoas magnus* and *iliacus* are much blended, and have remarkably extensive fleshy insertion; the same may be said of the two smaller *glutæi*. We can find no trace of *scansorius* nor of *tensor fasciæ late*. There are three perfectly distinct *adductores femoris* besides the *pectinaeus*, making a fourth. *Pyriformis* is present; so are *quadratus femoris*, and the two *obturatores*, though the latter has no origin within the pelvis (being shut off by the ischio-coccygeal muscle) and does not develop *gemelli*. There is another little ischio-femoral muscle that we do not identify. Further details will be found under special heads of the muscles; but we may add here, that the femur, like the humerus, is extremely short, thick, strong, and irregular in superficies, contributing by its shape to forcible, rather than extensive, movements of the limb. It has scarcely a "neck;" its large head is embedded between two expanded trochanters of nearly equal size, projecting like ears or wings on opposite sides; below these the bone rapidly narrows to expand again into large condyles, whereof the outer is especially developed for extensive fibular connections. It is curious to find that there is no noticeable groove between the condyles in front, although there is a very large and well-formed patella; this is contrary to the general proposition, that depth of groove and size of patella are reciprocal or complementary, if, indeed, they have not a relation of cause and effect. The enormously expanded peronecranon reaches half way up the femur. The thigh is permanently abducted and rotated outward.

(a'. — From the body; "long.")

Discretion of *ectoglutæus* from the femoral group leaves only the following muscles to be considered in this connection:—

Psoas magnus. — Small, with distinct origin above, from the two lowest lumbar vertebrae; but inseparably blended, before passing the brim of the pelvis, with the *iliacus*. (Description resumed below.)

Pyramiformis. — A thin flat triangular muscle that arises by three digitations from the fascia over the caudal vertebræ, and so, in effect, from the coccygeal spines themselves; it is wholly overlaid by the great glutæus; it lies, itself, upon lateral caudal muscles, proceeding directly transverse, narrowing as it goes, to be inserted by a thin narrow definite tendon into middle of femur behind, at foot of ectotrochanteric ridge, opposite the termination of the *glutæus minimus*. It abducts, and slightly rotates inward.

Quadratus femoris. — Below and behind the preceding, smaller, and ribbon-like. It arises from the two most prominent transverse processes of coccygeal vertebræ, in the septum betwixt the dorso-lateral and ischio-coccygeal caudal muscles, and proceeds outward and forward just behind the ectotrochanter, to be inserted into the middle of the back of the femur, opposite the insertion of the foregoing. It chiefly retroducts the thigh with slight abduction and inversion.

(b. — From pelvic arch; "short.")

Iliacus. — With the usual position and relations; above of small size, owing to the dimensions and contour of the ilium; but below, after fusion with the *ps. magnus*, remarkable for its great fleshy mass, that fills the interval between the ilium and pectinæal eminence, and its unusually extensive and fleshy insertion into the entotrochanter. After passing the hip-joint, which it directly overlies, it lies along the inner aspect of the femur, overlaid by the pectinæus, separated from the glutæi by interposition of rectus femoris. The insertion continues along the entotrochanter and thence down the bone nearly to the inner condyle. The usual actions of flexion and eversion are here very strongly displayed.

Glutæi (medius et minimus). — Though somewhat blended, still mostly separable, with due care, into an anterior (*minimus*) moiety, that is partly overlapped by a posterior and more superficial division (*medius*); both are completely separated from *ectoglutæus*. They arise together from the whole surface of the narrow ilium, from apex to acetabulum; and they are inserted, fleshy, *a*, *mesoglutæus*, chiefly, if not wholly, into the apex of ectotrochanter, and, *b*, *entoglutæus*, into the same trochanter and into the ridge descending thence for one-half inch down the shaft. These muscles are flexors from their origin and line of traction, while they also invert, from their insertion.

Adductor magnus. — The muscle which we thus homologize from its posterior position and extensive femoral insertion is smaller than either of the other adductors proper, although surpassing in size the pectinæus. It arises from the ischio-pubic ramus just in advance of the origin of the semi-tendinosus, by a rather long, thin, flat tendon; forms a thin, narrow triangle, passing outward to the thigh to be inserted in a line along the postero-internal aspect of the femur from

the middle of that bone quite to the inner condyle. Above, its insertion is in relation with that of the pectinæus; below, with femoral head of gastrocnemius and insertion of the semi-tendinosus. It is almost a pure extensor, having little adductorial action, if any.

Adductor longus. — A prismatic muscle, with one surface superficial (except that it is covered by the *gracilis*), and one edge and two surfaces wedged down between *adductor magnus* and *brevis*. It arises by itself from the horizontal ramus of the pubis, a little toward the median line from the articulation of the marsupial bone, and very near the symphysis. It has definite abrupt insertion by a short tendon into the inner condyle, between the insertions of the last and the next. It is a pure adductor, and a strong one.

Adductor brevis. — A flattened fusiform muscle, lying anterior to the last, upon the *pectinæus*, which separates it from *ps. magnus* and *iliacus*. It arises from the process upon the horizontal ramus pubis at outer corner of articulation of the marsupial bone, and runs straight to a definite insertion, by a short, roundish tendon, into the inner condyle, just above the insertion of the last. A pure adductor.

Pectinæus. — A very small, flattened-oval muscle arising by a terete tendon from the deep notch at base (in front) of the remarkable pectinæal eminence, passing outward and backward upon the *ps. magnus*, overlaid by *adductor brevis*, to be inserted, by a rather long, narrow, thin, fascia-like tendon into the postero-internal ridge of the femur, near the middle of the bone. It is a *flexor*, and evertor *femoris*, with action not very different from that of *ps. magnus*, but feeble.

Of these four adductorial muscles, it may be said briefly, that the two middle ones are adductors proper, the action of which may merge into either flexion or extension, in extreme postures of the thigh; that the first described is always extensor and barely adductor, while the last is always flexor and barely adductor.

It will be observed that the usual essential arrangement of four adductorial planes is preserved, the hind extremity offering no such deviation in this respect as the fore does in its division of coraco-brachialis into two, and their high development; a circumstance highly favoring the reference of the four adductors to coraco-brachialis and pectoralis major, that has been made by Wilder.* The question whether the adductors are, or the pectinæus is, to be referred to pectoralis, and conversely, probably finally hinges upon determination of pubis as = coracoid, or as = clavicle. The present indication, from the extensive development of two coraco-brachiales, is, that these are represented in the hind limb by the adductors proper, leaving pectinæus as the correlative of the pectoralis.

*Op. cit. p. 32.

Three ischio-femoral muscles remain to be described; their determination may be attended with difficulty. One (*a*, see below) is pretty obviously *obturator externus*; another (*b*) appears like a partial segregation from *a*; the third (*c*) should represent *obturator internus*, although it is cut off from the inner surface of the ischium, has no radiation of tendon, and is unaccompanied by gemelli. All three proceed to the back part of the femur, at the expanded intertrochanteric surface, instead of conniving at a "digital fossa."

a. — With broad rounded origin from the whole outer surface of the ischium and obturator membrane, narrowing as it passes straight outward and forward across the back of the hip-joint to definite insertion (see above) between the insertions of *b* and *c*.

b. — Like a part of the preceding, and somewhat blended therewith, but mainly distinct. It arises fleshy from the base of the ischio-pubic ramus along and below the articulation of the marsupial bones, and from the upper margin of the obturator foramen; passes back of the hip-joint and entotrochanter to a broad, fleshy insertion into most of the expanded intertrochanteric space. This and *a* extend and evert the femur.

c. — Arises fleshy from the whole of the thickened concave posterior border of the ischio-iliac ramus, from tuber ischii to acetabulum; passes outward and forward across the back of the hip-joint to the ectotrochanter, where it is inserted fleshy into the border and back surface of that process just below its apex. Its action is similar to those of the two preceding.

In examining the operations of the muscles that collectively act upon the femur, there is probably not much to note, after we have seen the permanent abduction and eversion of the thigh. The general preponderance of extensors over flexors, etc., is in relation to the force of the backward stroke in swimming. The more interesting features of the hind limb are shown mainly from the knee downward.

b. Acting upon the leg.

The most remarkable thing about the crural muscles is the presence of the *intertibialis* (a feature unique in mammalian myology?). Probably the next most so, is the entrance of the enormous *ecto-glutæus* into the crural instead of the femoral group, its low insertion at the foot, and its connection there with a *caudo-tibial extensor*. Although the latter muscle occurs among marsupials, here we have it under special conditions. The *gracilis* is second only to the great glutæus in bulk, and sends a peculiar slip backward to the cloaca. The *biceps* is large and though rather unusually thin and fan-shaped, is exhibited in the normal condition of that muscle; that is, with only one (an ischial) head, and no femoral attachment — its bicipital dis-

position, with a femoral head, being an accident of higher mammals. The *rectus*, as usual among lower beasts, is discrete from the *vasti*; these are blended together, with no evident *cruræus*. The *sartorius* is a flexor cruris, and, therefore, not in its normal office; but it is interesting to note, that its origin is relegated to the pelvis, and placed lower down than in some animals, as marsupials, above this monotreme; whereas, a higher, even a vertebral origin would have been anticipated, in view of the animal's ornithic tendency. The motions of the leg at the knee-joint, and actions of the muscles, will be noted after the special descriptions.

(a'. — From the body; "long.")

We cannot demonstrate any satisfactory distinction between the *ectoglutæus* and the "flexor accessorius a caudâ ad tibiam tendens," nor between this last and the "intertibialis." With howmuchsoever difference in their origin, course, and function, the three blend in some or another part of their extent. They form collectively an enormous flexor cruris, effecting a powerful backward pull (extension) of the whole limb. *Ectoglutæus* is also an outward rotator and abductor of the limb; the caudal muscle a direct retroductor (and flexor cruris), while the slip passing from one tibia to the other, is an adductor drawing the heels together under the tail, besides being a flexor cruris. The details of this singular arrangement, which probably, from its advantageous traction, acts more powerfully, for its size, than any other muscular apparatus of the limbs of mammals, are these:—

Ectoglutæus arises along the median line over the back of the sacrum and several anterior coccygeal vertebræ, in apposition with its fellow, in a straight line from the apex of the ilium downward to a point on the tail opposite the origin of the panniculus. Except in being overlaid by the last named, it is wholly superficial, resting above upon the other two glutæi, the *pyriformis*, and the dorso-lateral caudal extensor; farther down, lying upon the last mentioned, and part of the biceps, from the origin of which, however, it is separated by the width of the tail at the part. The upper fibres run very obliquely backward; the others have successively more and more transverse direction, and finally the lowermost run outward and a little forward. At the posterior extremity of origin occurs an interval, equal to the distance between the spinous and the transverse processes of the coccygeal vertebræ; then a stout bundle of fibres — the *flexor accessorius* — takes fleshy origin from the tip of the transverse processes of two or three vertebræ, and soon blends with glutæus proper. From the anterior border of flexor accessorius, *intertibialis* becomes differentiated about an inch from the leg, and passes directly transverse across the tail below, rather more than an inch in front of the anus, to be continuous with its fellow of the other side; it is attached to the pannic-

ulus where it crosses the median line. The insertion of this extensive apparatus is rather diffuse, and may not always be exactly as we made it out in this specimen. Glutæus proper becomes tendinous, or rather fascial, dips among the tendons of the back of the leg just above the heel, and thus has indefinite insertion, but is mainly prolonged over base of the spur, and heel, to be continuous with plantar fascia. The caudal part, on the other hand, has definite insertion into the tibia; twisting for that purpose, much as latissimus or pectoralis major does, so that the most anterior fibres (those that give off the intertibialis) are inserted lowest down. The insertion is in the middle third of the tibia behind, for about half an inch, opposite the insertion of the gracilis. The plantar attachments doubtless cause the muscle to act somewhat as an extensor of the foot—in obvious subserviency to advantageous action in giving the back-stroke.

(b'. — From the pelvic arch: “long.”)

Biceps.—The external or fibular flexor cruris is a single-headed broadly triangular muscle, without femoral origin. It arises definitely from the tuber ischii, at first overlaid by the ectoglutæus; as it emerges from under which, it rapidly widens into a broad and comparatively thin plane that spreads over nearly all the leg, in apposition, at first with the tibial flexores cruris that also arise from the ischiatic tuberosity, and afterwards with the great fibular head of the gastrocnemius and other peroneal muscles. Partly in consequence, very likely, of the burial of the fibula in muscle, the biceps has no actual insertion into that bone, except just at the upper margin of the spatulate peronecranon. Muscular fibres terminate, in a curved line corresponding to the outer border of the calf of the leg, in a broad dense aponeurosis that sweeps over and envelops the whole front of the leg, with final definite insertion into the crest of the tibia from the patella two-thirds way down the leg, besides sending below sundry fascial prolongations between the tendons of anterior tibial muscles. This actual insertion of the *outer* (fibular) flexor cruris into the *inner* bone of the leg occurs in marsupials also, as, for instance, in the *Didelphys virginiana*, where it offers a highly interesting analogy to the *ulnar* insertion of one foot of the biceps brachii of the same animal. The actions of the *Ornithorhynchus* biceps cruris are several; firstly, it retroducts the femur and extends the whole limb; secondly, it is a flexor of the leg; and thirdly, it is a powerful external rotator of the limb below the knee, turning the heel directly towards, and the claws away from, the body. The mechanism of the knee-joint, as explained below, allows this action, which is furthered by the way the aponeurotic tendon of insertion of the biceps laps over the swelling muscles of the calf, as a band over a pulley.

Gracilis.—Of great size. Arises fleshy, in apposition with its fellow for the whole length of the symphysis pubis, and greater part of outer surface of marsupial bone. Above, it is connected with the symphyseal aponeurosis of the obliquus externus abdominis; below, with a slight tendinous intersection, it sends straight backward the peculiar slip that goes to the cloaca. The muscle passes nearly transversely outwards, overlying all the other tibial flexors as well as the femoral adductors. Its posterior border is curved and somewhat tucked under, while the anterior border is straight; the muscle converges and grows at the same time thinner, to be inserted by a short, flat, broad tendon into the shaft of the tibia, for half an inch along the middle third of the bone. Primarily, the gracilis is a strong direct adductor of the whole limb; next it flexes the tibia, and finally rotates the leg inward.

Semitendinosus and *Seminembranosus* have continuous origins and insertions, parallel and contiguous courses, and similar functions: neither displays the physical structure that led some one to encumber anatomy with two of the most unhandy and inept names in the science. Both are direct flexors of the leg, and extensors of the whole limb, with a little inwardly rotating action. The *one-half membranosus* is the posterior of the two; it has definite origin from the tip of the ischium next to the biceps; is of a flattened terete shape, taking straight course to the leg, where it has extensive fleshy insertion for half an inch along the upper third of the tibia, just to one side of its crest. The *one-half tendinosus*, has more extensive and chiefly tendinous, but also partly fleshy origin from the ascending ramus of the ischium, between the origin of the foregoing and that of the adductor. It forms a prismatic muscle, owing to its flat under and superficial, and bevelled posterior, aspects; the *one-half membranosus* resting on the latter. It converges abruptly to a point, with definite tendinous insertion into the head of the tibia, at the most internal and projecting point of the latter.

Sartorius.—Here its true office as an extensor cruris and flexor femoris is contravened, and we find the muscle, much as in man, at once a flexor of two consecutive segments. Its low, instead of high, pelvic, or even vertebral, origin has been already mentioned. It arises from the apex of the pectinæal eminence, in connection with the insertion of the *psoas parvus*, by a round cord-like tendon; passes outward upon the inner aspect of the limb, overlying pectinæus and adductors, expanding remarkably as it goes, into a flattened, triangular muscle. Narrowing somewhat, it becomes aponeurotic just below the internal condyle of the femur, and is attached to the naked space in front of the tibia above, though really continuous with the somewhat similar fascial expansion of the biceps. It is, firstly, an adduc-

tor of the whole limb; secondly, a flexor femoris; thirdly, a flexor cruris; and finally, it rotates the leg a little inward.

Rectus femoris. — Entirely distinct from the rest of the “triceps extensor cruris,” which, as a whole, is not very highly developed. Rectus has definite origin by a stout, flattened tendon from the bottom of the iliac shaft, just above and in front of the acetabulum. The tendon radiates upon the surface of the muscle, and helps to keep it discrete from vasti. The muscle enlarges below, forming a pyramidal belly that passes between and separates iliacus and glutæus minimus. Farther on, it partly separates in two; a superficial portion, the larger, has virtual insertion into the patella; the deep portion, smaller and thinner, runs down fleshy over the face of this sesamoid, to be inserted with the ligamentum patellæ into the head of the tibia by a fascial expansion. A pure extensor cruris.

Vasti. — There is no “cruræus,” although with the exercise of the ingenuity that anthropotomy has developed, such might perhaps be invented. The two vasti form a single fleshy mass of moderate size, arising from the whole of the broad anterior femoral surface, from the insertion of psoas and iliacus on one side to that of glutæi on the other. The insertion is fleshy, into the patella, its whole width. The great size of this bone, and its remarkably distinct ligament for tibial attachment, give it less appearance of a sesamoid than usual. The vasti are pure extensors.

Both crural bones articulate extensively with the femur; and the conformation of the knee-joint in other respects, is such, that the leg enjoys rotatory movements equivalent to pronation and supination, and more closely resembling those of the elbow than is usual in the mammalian series. The oar that the foot makes, like that of the hand, is feathered at the joint above. Examination of above described actions of muscles moving the leg will show how this is accomplished; while certain motions at the ankle, to be readily appreciated from the notice of the leg muscles that here follows, further the design of bringing the limb forward with the edge of the web cutting the water, and carrying it backward with directly opposed broad plantar surface.

Poplitæus. — The proper rotator of the leg is of large size, and, as usual, deep-seated at the back of the knee-joint and leg. It arises fleshy from the inner corner of the crest of the fibula for a third of an inch; passes obliquely across the joint, and downwards, to the tibia, gaining some fibres of origin from the articular head of the fibula as it passes that point; but we made out no femoral attachment. It is inserted fleshy into the broad flat space on the back of the tibia, just below its head.

If this muscle really is poplitæus, here we have it without femoral

relations, and more nearly resembling in its attachments, course and function, the "interosseus cruris" of some animals, which is not developed in the present instance.

This muscle is decidedly not to be referred to the pronator radii teres.

c. Acting upon tarso-metatarsus — from femur or leg, or both.

The great size of the spoon-shaped peronecranon, from which nearly all the muscles of the foot arise, either wholly or in part, effects (*a*) greater power of such muscles, in consequence of actual increase of contractile mass, (*b*) advantageous rotatory operation, and (*c*) a very peculiarly shaped calf. On the front and outer side of the leg, the muscles rather suddenly contract to tendons at about the middle; those behind run nearly to the heel; all are very closely packed above, while below, the tendons are much separated by intervention of fascial and adipose tissue.

We may note, at the outset, that "peroneus tertius" occurs here in its true character of extensor minimi digiti pedis — a common, if not the customary condition of the muscle in animals below the highest; our notion of its antitypic relations with a muscle of the fore limb is given further on. The digital extensor set is double in the leg; *i. e.*, the deep set, that in man, etc., is restricted to the instep, here runs up the leg. In some marsupials, *e.g.*, opossum, the same muscle is peroneal, and deflects behind the malleolus externus before distributing its tendons to the digits. Here it comes directly down the front of the leg and is clearly displayed as one of the true digital extensors, corresponding to the special extensores pollicis and indicis, in the hand. Extensor longus hallucis is present and of usual characters.

Flexor tarsi tibialis; h. e., Tibialis anticus.—The innermost muscle upon the front of the leg; large; superficial; arising by two heads. The smaller of these takes fleshy origin from the tibial shaft in front, from its head half way down; and is divided by a cellular interspace from the other, the larger, head which arises from the patella and a corner of the peronecranon in apposition with the extensor hallucis. The two join and become tendinous at the middle of the leg; the stout tendon passes in front of the inner malleolus, most internal of any, to its customary insertion into the base of the first metatarsal. The usual action.

Extensor tarsi tibialis; h. e., Tibialis posticus.—A large, very deep-seated muscle upon the back of the leg, filling the wide interosseus space, but having no tibial origin. It consists essentially of two parts; the shorter and thicker of these arises from the articular head of the fibula, and a ridge thence two-thirds way down the tibial aspect of that bone; the longer and thinner part from the back of the shaft of the fibula and most of the posterior surface of the perone-

cranon. It is overlaid by the plantaris, has the flexor longus digitorum to the outside, and the popliteus to the inside. Its tendon passes behind the inner malleolus to be inserted at the most prominent point of the inner aspect of the tarsus.

Plantaris. — A muscle of great size, comparatively. It arises fleshy from the posterior surface of the peronecranon, and its crest, between popliteus and tibialis posticus, and lies in a sort of bed formed by the last named. It continues fleshy two-thirds way down the leg; then its stout tendon, instead of passing with tendo Achillis to the os calcis, glides behind the inner malleolus, and expands into a strong plantar fascia.

Gastrocnemius. — Of rather remarkable conformation; its two heads are widely separated, and very different in shape; one is much larger than the other. The larger arises fleshy from the outer one-half or two-thirds of the fibular crest, and immediately forms an immense bulging mass that rivals, proportionally, the human calf itself; this lies upon the outer side and back of the leg, mostly upon the fibular flexor of the toes. It forms a stout tendo Achillis at the lower third of the leg, with the usual calcaneal insertion. The tendon has aponeurotic expansion upon the outer surface of the muscle. The smaller head arises fleshy from the inner femoral condyle, at its back, just above the capsular ligament of the knee-joint. It is thick at first, but soon becomes flattened into a ribbon-like muscle that passes very obliquely outward down the leg, to join the outer gastrocnemius at the middle of the leg with a sort of tendinous intersection — one side being as it were partly laid over the outer gastrocnemius, the other directly continuous. This construction, though in evident relation to rotatory powers of the leg, is barely a foreshadowing of that complete separation of the two gastrocnemii, and presence of two tendones Achillis, that obtains in some marsupials.

Peroneus longus. — A large superficial muscle upon the antero-external aspect of the leg, lying upon "peroneus tertius" and extensor longus digitorum, in relation internally with extensor hallucis. It arises fleshy from the outer moiety of crest and adjoining anterior surface of the fibula; forms a thick spindle-shaped belly, and becomes tendinous just below the middle of the leg. Its tendon proceeds along the outer aspect of the outer malleolus, a little in front of it, if anything, rather than behind it, gains the side of the ankle in front, and dips below the base of the 5th metatarsal. It then, as usual, traverses a groove obliquely across the sole, along the conjoined heads of the metatarsals, to be inserted into the base of the 1st.

Extensor hallucis. — The next muscle to the *tibialis anticus*; a long, roundish, but somewhat compressed belly arising from a tubercle on the outer aspect of the tibial head, and from contiguous portions of the peronecranon. Its tendon, which forms about the middle of the

leg, passes at first obliquely across the middle of the instep, and thence more laterally to gain the great toe, upon the surface of which it runs to the base of the ungual phalanx. It is a large muscle, wholly superficial, and, like the tibialis anticus, is partly separable into tibial and fibular heads of origin.

Extensor "longus" digitorum. — Smaller than either of the muscles upon the direct front of the leg, with a short belly and a long tendon; it is deep-seated, covered over by the preceding, and in apposition with the peroneal muscles proper. Its origin is wholly fibular, by a short, stout tendon, from a tubercle on the articular head of the fibula, and it lies wholly upon this bone. Its long slender tendon passes a little obliquely down upon the fibula, then along the groove between the bone and the tibia, just internal to the tendon of the next described muscle. On the instep it spreads into a fan-shaped fascial expansion that covers most of the dorsum, and is then differentiated into 4 tendons that supply, in the usual way, all the digits except the great toe.

Extensor "brevis" digitorum. — This is the muscle that in man occupies the instep; here carried up the leg; not, however, as in opossum, etc., to form a peroneal muscle passing behind the outer malleolus, but coming obliquely down the leg in front, crossing the fibula below, gaining the groove between this bone and the tibia, alongside the tendon of the foregoing. The muscular part is the most deep-seated of any on the front of the leg, and the smallest of all; a thin little plane arising from, and lying upon the expanded surface of the fibula opposite and a little above the articular head of this bone. The tendon that it soon forms is *flat*, and, with the course just mentioned, spreads, after passing the ankle, into a large fan-shaped plane, similar to, and lying underneath the plane of extensor longus. It is difficult of being distinguished into tendons, but with some care may be demonstrated to proceed to all five digits, and nearly or quite to their tips. In its digital course, it is closely connected with the sheath of the toes, and it runs rather along their sides than directly upon their dorsal aspects.

Extensor minimi digiti. Peroneus tertius. — The third peroneal or flexor tarsi fibularis of anthropotomy is a muscle of considerable size, that lies upon the extensor "brevis" digitorum, on the front of the fibula, and is overlaid by the p. longus. It is a flattened strip that arises fleshy from the crest of the fibula and contiguous anterior surface, narrowing regularly as it descends, and becoming tendinous a little below the middle of the leg. Crossing the tendon of p. longus, its tendon gains the outer border of the foot, at base of the 5th metatarsal, and thence runs along the little toe to be inserted into the base of its ungual phalanx. It is an abducting extensor of that digit.

This muscle, which, in man, is inconsiderable and appears like an off-

set of the common long extensor of the digits arrested at the base of the fifth metatarsal, here appears in what we hold for its true character. It has the same disposition and relations in some marsupials. We consider it the antitype of the extensor ossis metacarpi pollicis. At first sight, especially in view of its running to the extremity of the little toe, one might think it rather referable, if to any of the thumb muscles, to one or both of the extensors of the pollical internodes, when these are present, as in man. But these last appear to be decidedly dismemberments of a common deep extensor set, of which the special extensor indicis is another; and these are already amply accounted for by the extensor brevis digitorum pedis.

Flexor digitorum longus (fibularis).—There is no tibial flexor of the toes; the fibular flexor gives off part of the large tendons that go to terminal phalanges, the others being supplied by a muscle of the sole, that occupies the situation of the human "flexor accessorius." The flexor is a very large muscle that arises fleshy from the outer aspect of the shaft of the fibula, its upper half, and thence up along the back surface of the ridge that runs up the crest; and from the outer corner of the crest itself; it is partially contained betwixt the gastrocnemius externus and the peroneus longus. At the lower third of the leg, it develops a stout tendon that runs some way upon its outer surface, giving a dense glistening aponeurotic investment. The tendon passes behind the middle of the heel, in a deep groove alongside the calcaneum, where it becomes flattened, and soon splits into only *three* tendons. Two of these, that appear to be the most direct continuations of the original tendon, run to the ungual phalanges of the first and second toes; the third divaricates more, and passes between the two heads of the flexor brevis minimi digiti to its insertion into the base of the ungual phalanx of the little toe. Thus the 3d and 4th toes are so far unsupplied with large tendons, from this muscle.

Flexor sublimis (brevis) digitorum pedis.—We should judge from its appearance in the specimen that it might be larger, and even supply more digits, than we found to be the case in this instance. It forms a short, flat, fleshy belly, lying upon, and arising wholly from, the flattened tendon of the foregoing, with no osseous origin. It divides below into *two* tendons only, that are lost in the digital sheaths of the 2d and 3d toes near their bases.

This appears to be the antitype of the muscle of the same name in the hand. The muscle has a similar disposition, and arises in the same way from the tendon of the main flexor, in the opossum, although in this animal it is carried half way up the leg.

Thus far, we have seen no tendon going to the 4th digit. This is supplied by a little muscle of the sole that lies in the position of flexor accessorius of anthropotomy, though decidedly not to be morphologically identified therewith. We hold it on the contrary to be

really a dismemberment of the long common fibular flexor, restrained to the foot, just as the muscle that sends the single tendon to the opossum's great toe is. Ordinarily, perhaps, in unguiculate mammals at least, there are *two* long deep digital flexors, one tibial, the other fibular, the distribution of the individual tendons of which is variable. Thus in man, one goes to the great toe alone, the other to all the rest of the digits; and the two seem to have, as it were, exchanged places, since their tendons cross to reach their respective destinations. In the next animal, viz., the gorilla, it is the *other* muscle that gives off the most tendons. In the opossum, for example, the flexor hallucis occurs, and is on its proper, viz., tibial, side of the leg; but its tendon aborts at the heel, being there fastened to the common tendon; and its place is supplied by a little plantar calcaneal muscle that crosses the foot obliquely and gives off a tendon as large as any from the common flexor; this tendon runs between the heads of the flexor brevis hallucis, and is inserted in the usual manner into the base of the distal phalanx of the great toe. Now in the *Ornithorhynchus* with only one long deep flexor digitorum, we have a similar arrangement, though with a little variation. The plantar dismemberment of the common long deep flexor digitorum forms a short, fleshy belly that arises from the side of the os calcis, and soon becomes tendinous, dividing into *two* tendons that pass to terminal phalanges of the 3d and 4th digits. These tendons are fully as large as those coming down from the leg, and have identical disposition upon the digits.

All that has just been said has reference only to the subdivisions of *one*—the long deep—set of digital flexors; that is, it is without bringing into the discussion the above described flexor “brevis” or *sublimis*. The latter corresponds to the muscle of the same name in the hand. The former (flexor longus digitorum) is so variously differentiated into two muscles and several tendons in the mammalian series, that it is safest, as well as most philosophical, to regard it as a morphological integer, susceptible of varying dismemberments, which, as a matter of fact, supply different digits in different animals. The corresponding muscle of the hand is probably in most unguiculates single, with *five* identical tendons; when, as in man, it is differentiated into two, one of these is flexor longus pollicis, the other flexor digitorum profundus. In the foot, the muscle is probably usually divided into two that have, with different animals, different digital distribution, as just stated. It will be found best to distinguish these two simply as respectively ‘fibular,’ and ‘tibial,’ without reference to the particular digits that either supplies.*

*In drawing antitypes of the deep digital flexors of *man*, it must be remembered, that, as above mentioned, the human flexores *tibialis* and *fibularis* have, as it were, changed places, so that flexor hallucis is the correlative of the flexor digitorum profundus, and flexor longus digitorum pedis of the flexor proprius pollicis.

(b.' — From tarso-metatarsæ.)

Although the little calcaneal muscle, just discussed, really lies wholly on the sole, yet it belongs to the last group, and we only now come to muscles of the digits that may be properly called tarso-metatarsal. As usual, these are more numerous and bulky upon the plantar than upon the dorsal aspect of the foot. They are chiefly the special muscles of the great and little toes. We find but one for the hallux, while on the other hand, three may be demonstrated upon the little toe. In this animal, there is absolutely no specialization of external form, etc., of the thumb and great toe; while these digits are, if anything, less favored with special muscles than either the little finger or little toe is. Here, at any rate, nothing but the difference in the number of the internodes stands in the way of the correlation of the little toe with the thumb, and conversely, of the great toe with the little finger.

Flexor brevis hallucis. — A very small and insignificant muscle lying upon the first metatarsal; it arises near the base of this bone, and is inserted by two heads into either side of the base of the great toe, with a pair of sesamoids. We can distinguish no other muscle upon the ball of the great toe. It directly flexes.

Flexor brevis minimi digiti. — A short, plump muscle, almost entirely fleshy, that arises from the os calcis, passes down over the next muscle, divides into two heads, between which runs a tendon of the long fibular flexor digitorum; they are inserted into either side of the base of the little toe.

Abductor minimi digiti. — A flattish, fleshy muscle, lying along the outer border of the foot, filling up what would otherwise be a depression between the os calcis and the head of the 5th metatarsal, arising from the former, and inserted into the outer aspect of the basal phalanx of the little toe.

Adductor minimi digiti. — A well developed, distinct, long, flat strip of muscle arising near the head of the 3d metatarsal at the centre of the sole, and passing obliquely outward and forward to be inserted into the inner side of the base of the 1st phalanx of the little toe.

This muscle seems to be the largest and outermost of a series of four that diminish successively from the 5th to the 2d toe. They arise near together, along a line corresponding to the passage of the tendon of the peroneus longus across the sole; and each is inserted into the inner side of the base of a digit. They are apparently spreaders of the web, like the interossei from which, however, they are wholly distinct.

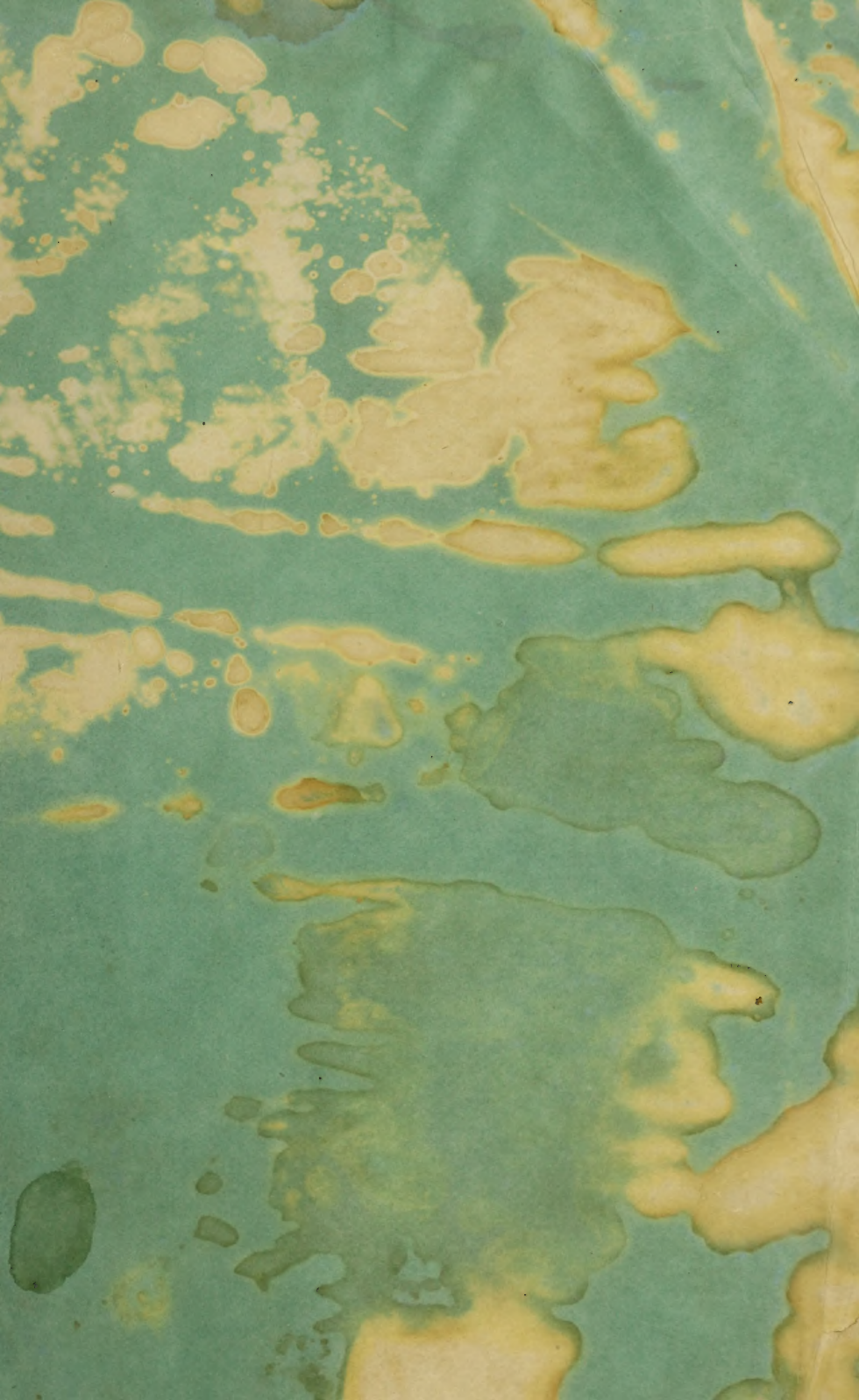
The *plantar interossei* lie wholly upon, instead of between, the metatarsals, and are well developed. They embrace the bases of the 2d - 4th digits. The dorsal were not specially examined; they appeared to be inconsiderable.

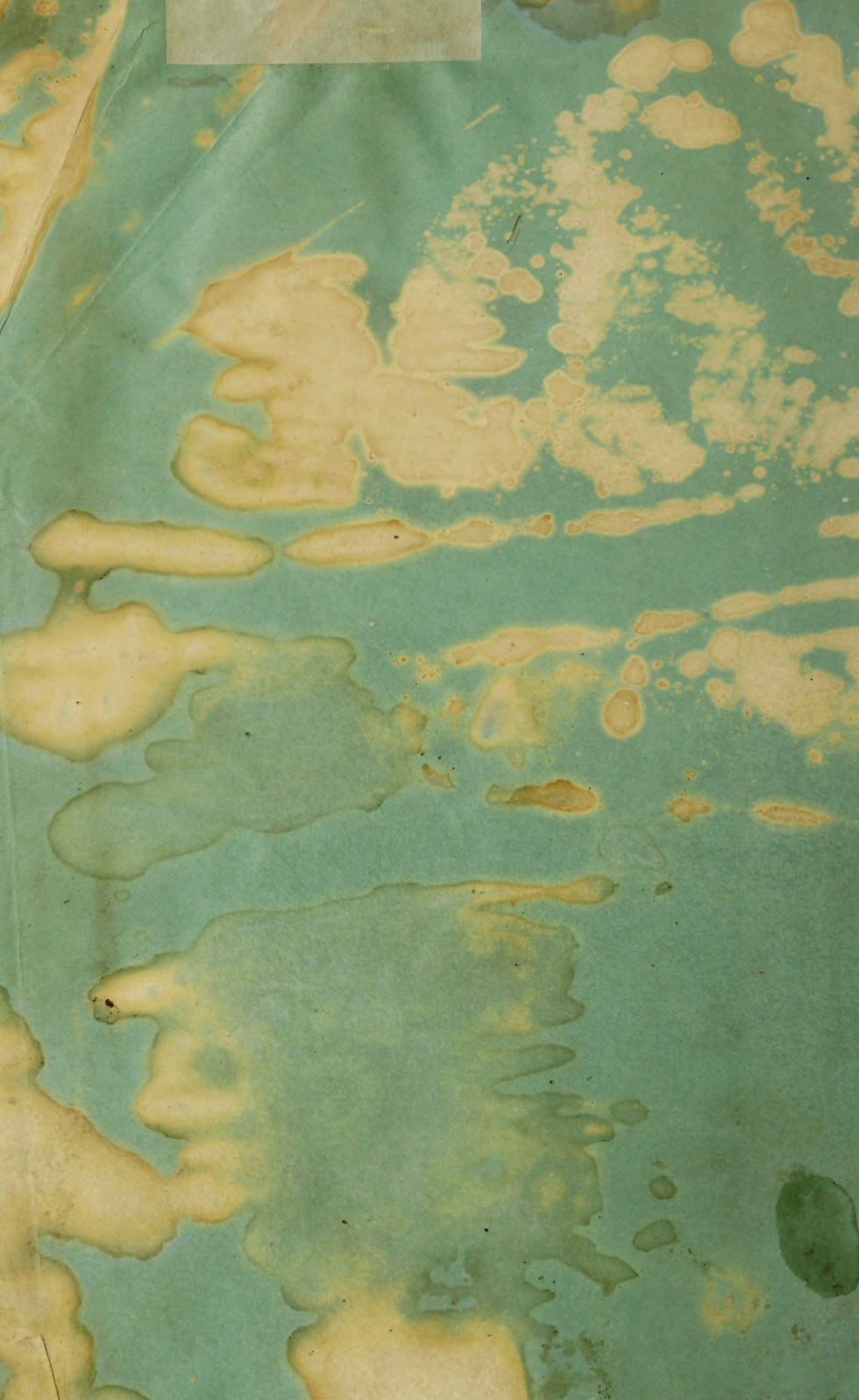
It is only just to ourselves to say, in concluding a necessarily im-

perfect article, that the circumstances under which it was prepared deprived us of the advantage of consulting Meckel's memoir, or anything else that may have been published upon the subject, except the short notice in *Owen's C. A. & P. V.*, iii, pp. 2-7. This frank statement of our limited resources, so far from being made with any desire of disarming criticism, is intended to invite correction of errors we may have committed in identification of muscles; and this, we trust, a certain accuracy of descriptive detail will render comparatively easy.

We desire to record here our present conviction, that the identification, with entire accuracy, of the singularly modified muscles that lie upon the sauropsidan shoulder-girdle of this mammal, will go far toward establishing, in myology, the hypothesis of Antero-posterior Symmetry that is maintained by Wyman, Wilder, and the writer.

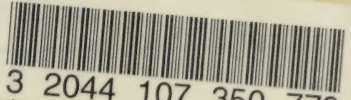






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